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ABSTRACT

Biology, Chemistry, Earth Science, Physics, and Ecology assessment instruments were administered to approximately 1,800 nine year old and 1,800 seventeen year old Massachusetts students. The 9 year old students exceeded the performance of a national and international sampling of students. They equaled the performance of a sampling of students from the northeastern United States. Seventeen year old students equaled the performance of the national sample, but fell below the achievement of both the northeastern and international samples. Both 9 and 17 year old students from residential suburban and other communities tended to perform higher than those students from the large city and industrial suburban communities. For both 9 and 17 year olds, about twenty background and experience factors were examined for their relationship with assessment performance. Most of the association between these factors and achievement in 17 year olds was accounted for by the amount of laboratory experience that the student had in physics and chemistry, and whether or not the student reported discussing scientific matters with friends outside of school. The three factors that appeared most often for 9 year olds were type of community, parents' occupation, and sex. (Author/CTM)

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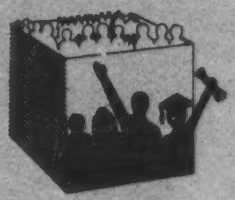
ED157933

SCIENCE AND ECOLOGY 1976-1977

MASSACHUSETTS EDUCATIONAL ASSESSMENT PROGRAM



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APPLICATION OF ASSESSMENT FINDINGS

The findings of the 1976-77 statewide assessment have, as do previous assessments, implications for educators and non-educators at both local and state levels. The first need, however, is to bring these findings to the attention of those most concerned, involved and interested. This is being done in three ways:

1) mass distribution of assessment publications to all school districts and departmental regional centers

2) publicizing of information about the assessment findings through normal media channels

3) holding of dissemination meetings at each of the Department's six regional centers during the fall of 1977

Following this, the Bureau of Research and Assessment, in conjunction with the Department's regional centers, plan to assist schools and other groups:

- in using state developed assessment instruments
- in analyzing and interpreting the results of assessment
- in adapting the procedures and test exercises of the National Assessment of Educational Progress (NAEP) to their own situations

Further information on the above, as well as other matters concerned with statewide assessment activities, can be obtained by contacting members of the Bureau of Research and Assessment (727-8497) or the regional center assessment coordinators listed on the next side.

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FOREWARD

Since 1974-75, the Statewide Educational Assessment Program has provided Massachusetts citizens with useful information about the quality of education in Massachusetts. The results of the assessment program, to date, have indicated to educators, parents, students, public officials and employers statewide patterns of performance in a number of areas including reading, mathematics, writing and citizenship/social studies.

This report describes the results of the assessment of student knowledge, understanding and attitudes in Science and Ecology.

As such, the report reflects the goals and objectives which the Commonwealth citizens consider relevant to Massachusetts' public education system. I am pleased to present this year's assessment findings for review by all interested citizens.

Charles Grigsby
Chairperson
Massachusetts Board of Education

HIGHLIGHTS

Science and Ecology Assessment instruments were administered to approximately 1800 nine year old and 1800 seventeen year old Massachusetts students. The 9 year old students exceed the performance of a National and International sampling of students. They equal the performance of a sampling of students from the Northeastern United States. Seventeen year old students equal the performance of the National sample, but fall below the achievement of both the Northeastern and International samples.

Both 9 and 17 year old students from Residential Suburban and Other Communities tend to perform higher than those students from the Big City and Industrial Suburban Communities. The one notable exception is on the earth science exercises for 17 year olds, where the Big City and Residential Communities score below the Industrial and Other Communities.

For both 9 and 17 year olds about twenty background and experience factors were examined for their relationship with assessment performance. For 17 year olds there was a strong association between several of these factors and student performance. Most of the association between these factors and achievement is accounted for by the amount of laboratory experience that the student has had in physics and chemistry, and whether or not the student reports discussing scientific matters with friends outside of school. For 9 year olds the association between these factors and assessment performance is much weaker than for 17 year olds. The three factors that appear most often for 9 year olds are their Kind of Community, Parents Occupation and Sex.

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I. BACKGROUND

HISTORY

In 1971, the Massachusetts Board of Education issued "The Results Approac to Education and Educational Imperatives", outlining fourteen priorities for D partment of Education attention. The first three priorities of the document a Define the educational results expected (goals); Measure the educational resul achieved (design for assessment); Establish result-oriented educational standa tied to goals.

In 1972, in response to the first priority, and through an effort involvi citizens throughout the State, the Board of Education published "Educational Goals for Massachusetts". This document described the ten broad goals to whic the educational systems of the State should aspire.

In July, 1973, in response to the second priority, the Board of Education approved the development of the statewide educational assessment program. Six regional assessment advisory committees, composed of teachers, educational adm istrators, employers, public officials, parents and students, were established to design the educational assessment program. Since one of the major goals of the assessment program is to provide information about the quality of education

on a statewide basis. the committees decided that a sample of students could be used to measure patterns of achievement.

During 1974-75, the Massachusetts Department of Education implemented the first phase of the statewide assessment program. The first phase addressed three of the state's ten educational goals--basic communication skills, effective uses of knowledge, and occupational competence. Performance information from samples of students throughout the Commonwealth was collected in reading, mathematics and decision-making for nine and seventeen year olds, and occupational knowledge and occupational attitudes for seventeen year olds only. In addition, a sample of citizens throughout the state were surveyed to determine their attitudes toward education and their evaluation of the Massachusetts educational goals.

During 1975-76, the Department of Education conducted the second phase of the assessment program. This phase dealt with six of the ten state educational goals--basic communication skills, effective use of knowledge, individual values and attitudes, respect for the community of man, citizenship in a demogratic society, and understanding of the environment. Performance information from samples of students throughout the Commonwealth was collected in writing, citizenship and social studies. A separate study was also made of Foreign language

performance among secondary school students with different lengths of exposure to instruction in French and Spanish.

In the spring of 1976, the Statewide Assessment Advisory Committee was asked to recommend the areas to be examined in the third phase of the program. On the basis of the Committee's suggestions to the State Board of Education, the 1976-77 assessment effort dealt with three of the ten state educational goals--basic communication skills, effective uses of knowledge and understanding of the environment.

In order to measure these goals, a sample of 8,000 nine and seventeen year old students throughout the state were assessed in Science, Ecology and Consumer Education. These assessments were conducted by Testing and Evaluation Services Company (TESCO), under contract with the Bureau of Research and Assessment. Two additional studies were made during 1976-77, one was an examination of the climate in a sample of high schools and the other was an exploration of the use of non-traditional assessment techniques such as group discussion and simulated performance. These studies were conducted for the Bureau of Research and Assessment by Training, Development and Research, Inc. (TDR).

PURPOSE

The overall purpose of the assessment program is to gather information that will indicate how well the Commonwealth's educational system is meeting its goals. It is not the purpose of the assessment to determine how well individual students, schools, or school districts perform. Accordingly, all components of the assessment program have been conducted on a random sample of students from all over the state. In any one school, and in many districts, a maximum of twenty students have been tested in any one subject. The data in these reports come from only one year of testing and can be useful as base-line information but the findings cannot be analyzed to show trends in the school systems of the Commonwealth. In addition, the reader should be aware that factors other than school programs influence performance. Knowledge, skills and attitudes are learned from parents, peers, and the media as well as from teachers.

Specifically, the assessment program serves four goals: first to provide the general citizenry, students, parents, legislators, and educators with more accurate and useful information about the quality of education in Massachusetts; second, to provide state-level decision-makers with detailed information necessary to make better informed policy decisions and recommendations about state-wide

educational activities; third, to provide citizens, school committees and schoo
administrators with information on patterns of performance as an aid in analyzi
local educational conditions and in setting local objectives; fourth, to make
available to school systems assessment procedures for use in developing and
implementing local assessment programs.

This Highlights Report is one of four summarizing the results of the third
phase of the assessment program. A more complete report of each part of the
assessment can be found in technical documents that are available in the office
of every school superintendent throughout the state.

II. OVERVIEW

THE TEST

The techniques used to measure patterns of performance in Science and Ecology are based on criterion-referenced tests. Criterion-referenced tests differ from the more conventional standardized tests in development and use. Standardized tests are designed to distinguish among students on such scales as percentiles and grade equivalents. Criterion-referenced tests provide information on how closely students come to meeting the performance objectives considered important by educators throughout Massachusetts.

The National Assessment of Educational Progress has developed criterion-referenced tests which measure three major science objectives in the content areas of Biology, Chemistry, Earth Science and Physics. In consultation with the Massachusetts Associations of Science Supervisors and Teachers, those items representing the objectives of Knowledge, Understanding and Appreciation which reflect Massachusetts concerns were identified and adapted for Massachusetts use.

In addition to National Assessment, science items were contributed from two other sources. First, relevant items were selected from the Science Edu-

cation in nineteen countries (IS) study. This study produced and tested sets of items at about the same time that the National Assessment studies were conducted, i.e., 1969 through 1973. Second, members of the Science Advisory Committee constructed items to measure relevant content-area objectives which were not measured by the National Assessment or IS project items.

SAMPLE SELECTION AND LIMITATIONS

Schools participating in this year's Assessment Program were selected at random from the Massachusetts School Directory of 1975-76. The sample was checked to insure that representation was obtained from every Kind of Community and Educational Region of the State. However, the final sample is not completely random, since several schools which had been selected for the third year in a row could not participate again.

Up to twenty-three students in each of ninety sample schools were then selected at random and tested, This resulted in slightly less than 1800 students being tested for each age group (i.e., nine and seventeen year olds).

Interpretation of relationships of student background, experiences and attitudes with student achievement must be made cautiously. The type of study represented by this Assessment does not identify causes, it only identifies

associations. If a particular experience is associated with higher achievement, does this mean that the experience produces higher achievement? Or, could it be that higher achieving students seek out this kind of experience?

SOME SCHOOL CHARACTERISTICS

Several items of information were collected about the elementary and high schools selected to participate in the Massachusetts 1976-77 Assessment. Table 1 shows the percent of school principals selecting the various item alternatives (except for Elementary item 3 which is the arithmetic mean of the principal's responses).

TABLE 1

Elementary and Secondary Sample-School Characteristics*

Elementary

1. Is there a science supervisor or coordinator assigned to this school?

   18% Yes

   74% No

2. Are there teachers who have a primary responsibility for teaching science?

   28% Yes

   66% No

TABLE 1

Elementary and Secondary Sample-School Characteristics
(Continued)

3. What is the average number of hours per week that a fourth grade student studies science in your school?

   2.1 hours

4. Would you prefer

   26% more time allotted to science

   67% the same time allotted to science

   1% less time allotted to science

5. Does the school have specific time allotted to studying ecology at the third or fourth grade level?

   28% Yes

   66% No

Secondary

1. Does this high school have a separate ecology course?

   37% Yes

   50% No

TABLE 1

Elementary and Secondary Sample-School Characteristics
(Continued)

2. If you answered no to question 1: Do specifically developed ecology lessons appear in the science courses?

80% Yes

16% No

*Percentages may not total 100 for a given item since in some cases information was not available or not supplied.

In the elementary school sample 74% of schools reported that they had neither a science supervisor nor a coordinator assigned to them. In fact 66% of the elementary school sample indicated that they do not have teachers who have a primary responsibility for teaching science.

On the average, elementary schools devote somewhat over two hours per week to science instruction. The minimum time per week of science instruction was 1 hour and the maximum 7 hours. Two thirds of the principals indicated thay they thought the time allotted to the study of science was about right. However, about one in four principals felt that more time should be allotted to the study of science in their schools. Finally, about two-thirds of the elementary schools

reported that there is no specific time allocated to studying ecology in the third or fourth grade curriculum.

For the high schools sampled, one half report that they do not have a separate ecology course. Of those schools that indicated an absence of separate ecology courses, 80% report that they do have specifically developed ecolo lessons in their science course. Therefore, about 77% of sample schools do provide some instruction in ecology.

DESCRIPTIVE DATA

One of the primary purposes of the assessment is to classify the findings in useful ways. Therefore, in addition to the assessment questions, all tests included a set of descriptive questions. All students were asked their sex, the grade in which they were enrolled, their feelings about school, in-school science and ecology experience, outside of school science and ecology experienc amount of discussion with friends and parents concerning science and the enviro ment, and attitudes toward environmental problems.

Two other distinctions were made among types of respondents from information not collected from the students themselves. One was educational region --

to which of the six Department of Education regions did a student belong. These data are displayed in Table 5. The other was the Kind of Community (K in which their school was located. Based on information concerning its size financial and demographic characteristics, each school district was assigned to one of four KOC's defined as: Big City, Industrial Suburb, Residential Suburb, Other.

Examples of Kinds of Communities are provided at the end of this report Table 2 shows the distribution of students according to Kind of Community. School systems can obtain their KOC code type from a listing of all communi in the technical report.

The composition of the sample of students for the Science and Ecology Assessment according to their descriptive characteristics is exhibited at t end of the report. No information is available that would allow identificat tion of individual students, schools, or school systems.

TABLE 2

Percent of Assessment Sample in Each of Four Kinds of Communities

Kind of Community	Percent of Sample	
	9 Year Olds	17 Year Olds
Big City	26	16
Industrial Suburb	19	9
Residential Suburb	19	39
Other	35	36

RESULTS

The same Content Areas and objectives were used to measure Science and Ecology skills among the nine and seventeen year old respondents. Table 3 shows the distribution of exercises used to assess each content area and objective at both age levels.

Many of the test items used in the Science Assessment have also been used by National Assessment with a national sample of students. Therefore, the Massachusetts results can be compared with the most recent National Assessment (i.e., 1973) data for the United States and for the Northeast Region. In addition, Massachusetts students can be compared to students who participated in

TABLE 3

Distribution of Number and Percent* of Items According to Science Content Area and Objective Type for Massachusetts Nine and Seventeen Year Old Students

Science Content Area		Nine Year Old Objective Type			Seventeen Year Old Objective Type		
		Knowledge	Understanding	Appreciation	Knowledge	Understanding	A
Biology	Number	8	4		6	8	
	%	15	8		11	14	
Chemistry	Number	2	4		4	5	
	%	4	8		7	9	
Earth Science	Number	5	2		2	2	
	%	9	4		4	4	
Ecology	Number	6	2	3	3	6	
	%	11	4	6	5	11	
Physics	Number	4	6		3	11	
	%	8	11		5	20	
Unclassified	Number	1	2	4		1	
	%	2	4	8		2	
Total	Number	26	20	7	18	33	
	%	49	38	13	33	60	

*Table cells may not total 100 due to rounding

the International Science Study from 1970-73. As exhibited in Table 4, Massachusetts 9 year old students significantly exceed the National and International Sample median % correct* and approximately equal the Northeast median % correct. Massachusetts 17 Year old students on the other hand, approximately equal the National Sample performance and fall below both the Northeast and International sample performances. The Massachusetts International Study discrepancy is similar to U.S. International Study differences, and is probably explained by different student retention rates among the countries (e.g., U.S. 75%, Scotland 17%, England 20%, France 29%). This retention rate difference is likely to result in a more select group of students from other countries taking the International Studies examination.

Table 6 presents, for each age group, the median performance scores by content area for the total Massachusetts sample, as well as students from the four kinds of communities in the commonwealth. A comparison by kind of community indicates that among Massachusetts 9 and 17 year olds, students from big cities and industrial suburbs tend to do worse than those from residential suburbs and other types of communities. A notable exception is for 17 year olds on the earth science items where industrial suburban and other community students perform better than both residential suburb and big city students.

*When exercises are arranged in order according to percent correctly responding the middle value (or halfway between the middle two for an even number of items) is the median % correct.

TABLE 4

NUMBER OF COMPARABLE KNOWLEDGE & UNDERSTANDING SCIENCE ITEMS AND MEDIAN PERFORMANCE FOR MASSACHUSETTS, NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS (NAEP), NORTHEAST (N.E.), AND INTERNATIONAL SCIENCE EDUCATION STUDENTS (I.S.)

	NINE YEAR OLDS						SEVENTEEN YEAR OLDS					
	MASS. & NAEP.[1]		MASS. & N.E.[1]		MASS. & I.S.[2]		MASS. & NAEP.[3]		MASS. & N.E.[3]		MASS. & I.S.[4]	
NUMBER OF COMPARABLE ITEMS	19		19		4		11		11		8	
MEDIAN % CORRECT FOR COMPARABLE ITEMS	71	63	71	70	49	45	52	51	52	57	36	55

1 includes biology, chemistry, earth science, and physics items
2 includes biology & earth science
3 includes biology, chemistry and physics items
4 includes biology and chemistry items

TABLE 5 MEDIAN-ITEM PERCENT-CORRECT BY SCIENCE CONTENT AREA AND EDUCATIONAL REGION*

		EDUCATIONAL REGION					
	MASSACHUSETTS	BOSTON	NORTHEAST	PITTSFIELD	SOUTHEAST	SPRINGFIELD	WORCESTER
NINE YEAR OLDS							
BIOLOGY	46	46	48	44	46	50	46
CHEMISTRY	60	60	58	72	60	58	64
EARTH SCIENCE	61	62	61	70	59	62	64
ECOLOGY	62	62	60	61	60	61	60
PHYSICS	54	55	50	54	54	59	55
UNCLASSIFIED	38	40	40	43	34	42	39
SEVENTEEN YEAR OLDS							
BIOLOGY	43	40	44	46	44	44	49
CHEMISTRY	34	32	32	24	33	32	38
EARTH SCIENCE	44	43	42	42	46	42	46
ECOLOGY	48	47	52	48	46	46	55
PHYSICS	34	30	38	30	33	30	39
UNCLASSIFIED	61	56	62	56	60	61	65

*Six groups of school districts from different regions of Massachusetts

TABLE 6 MEDIAN-ITEM PERCENT-CORRECT BY SCIENCE CONTENT AREA AND KIND OF COMMUNITY

		KIND OF COMMUNITY			
	MASSACHUSETTS	BIG CITY	INDUSTRIAL SUBURB	RESIDENTIAL SUBURB	OTHER
NINE YEAR OLDS					
BIOLOGY	46	42	42	52	46
CHEMISTRY	60	52	56	68	65
EARTH SCIENCE	61	54	57	70	64
ECOLOGY	62	56	58	64	63
PHYSICS	54	48	54	62	58
UNCLASSIFIED	38	36	42	47	44
SEVENTEEN YEAR OLDS					
BIOLOGY	43	38	39	46	45
CHEMISTRY	34	25	27	39	33
EARTH SCIENCE	44	35	48	34	47
ECOLOGY	48	38	40	56	50
PHYSICS	34	28	30	36	35
UNCLASSIFIED	61	50	54	66	61

CORRELATES OF STUDENT PERFORMANCE

In addition to test item data the 1976-77 Science & Ecology Assessment Program collected information on student background characteristics, experiences and attitudes. This additional data collection illustrated in Table 7 permits an investigation of the association between test performance and the student related factors. Such associations should provide direction to curriculum planners within local Massachusetts School districts.

Demographic Characteristics

Sex differences in median test performance vary according to age and content area. Where statistically significant differences appear they are in favor of male students. The largest difference is on the earth science items for 17 year old students (males 50%; females 38%). For several age groups and content areas, sex differences do not exist e.g., physics - 9 year olds (males 53%, females 52%), ecology - 9 year olds (males 64%; females 64%), ecology - 17 year olds (males 44%; females 45%).

In the National Assessment reports on the 1969-70 Science Assessment it was pointed out that sex differences in favor of males existed for all four age groupings that were tested (i.e., 9, 13, 17, and adult). in addition, this difference in performance increased with age.

TABLE 7

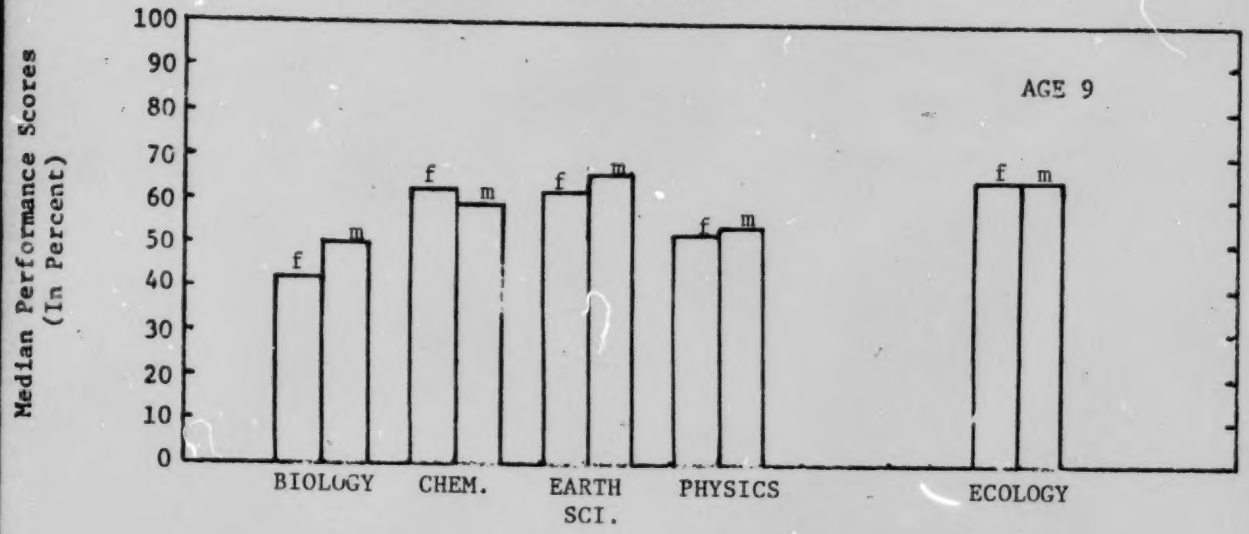
STUDENT CHARACTERISTICS, EXPERIENCE, ATTITUDES AND MEDIAN CONTENT-AREA PERFORMANCE

CONTENT AREA	BIOLOGY		CHEMISTRY		EARTH SCIENCE		PHYSICS		ECOLOGY	
AGE	9	17	9	17	9	17	9	17	9	17
SEX										
FEMALE	42	44	62	30	60	38	52	30	64	44
MALE	49	48	59	37	66	50	53	38	64	45
FAMILY OCC. STATUS										
LOW	46	36	54	25	56	42	53	30	60	40
MEDIUM	48	45	61	33	62	44	56	34	60	48
HIGH	48	46	64	38	67	44	59	36	63	53
LIKE SCHOOL										
LIKE VERY MUCH	43	49	57	39	58	45	50	40	58	54
MOSTLY OK	48	46	66	35	64	45	58	35	65	50
MOSTLY NOT OK	49	40	64	28	66	42	54	34	59	46
DISLIKE VERY MUCH	46	36	50	25	57	38	52	30	59	36
SEEN SCIENCE DEMO. OUTSIDE SCHOOL										
YES	48	48	64	40	66	47	58	37	62	54
NO	44	38	58	25	58	40	52	28	62	40
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL										
YES	47	50	62	37	63	48	56	36	63	51
NO	42	41	58	33	58	42	54	34	60	43
TALK ABOUT SCIENCE WITH PARENTS										
ONCE A WEEK OR MORE	49	58	64	48	64	50	56	39	66	64
A FEW TIMES A YEAR	49	47	65	38	66	46	58	36	63	52
NEVER	42	36	56	23	58	40	52	28	60	39

LE 7 STUDENT CHARACTERISTICS, EXPERIENCE, ATTITUDES AND MEDIAN CONTENT-AREA PERFORMANCE (cont'd)

CONTENT AREA	BIOLOGY		CHEMISTRY		EARTH SCIENCE		PHYSICS		ECOLOGY	
AGE	9	17	9	17	9	17	9	17	9	17
ABOUT SCIENCE										
FRIENDS										
ONCE A WEEK OR MORE	48	55	64	48	63	48	62	40	63	62
A FEW TIMES A YEAR	49	48	65	39	66	46	58	38	64	54
NEVER	44	36	56	23	58	40	52	28	60	38
ABOUT ENVIRON-										
WITH PARENTS										
ONCE A WEEK OR MORE	48	51	61	38	60	46	54	38	63	56
A FEW TIMES A YEAR	48	45	65	37	68	46	59	34	64	50
NEVER	48	34	56	23	57	38	54	31	59	39
ABOUT ENVIRON-										
WITH FRIENDS										
ONCE A WEEK OR MORE	48	44	62	35	64	46	54	34	63	56
A FEW TIMES A YEAR	49	46	66	38	69	45	58	36	65	52
NEVER	44	40	58	24	60	40	52	26	60	38
OOL HAD HELP-ENVIRON-										
PROJECT										
YES	48	46	61	35	62	45	53	36	63	52
NO	44	40	60	31	56	44	56	34	65	46
ENT PARTICIPATED IN										
-ENVIRONMENT PROJECT										
YES	46	46	62	34	61	44	54	32	60	50
NO	45	41	58	33	62	44	56	34	62	46
K ENVIRONMENTAL										
LEMS										
VERY DANGEROUS	41		54		56		49		57	
SOMEWHAT DANGEROUS	50		66		67		60		62	
NOT DANGEROUS AT ALL	42		54		54		47		58	

MEDIAN PERFORMANCE FOR FEMALES & MALES IN
FIVE SCIENCE CONTENT AREAS (BASED ON ALL ITEMS)



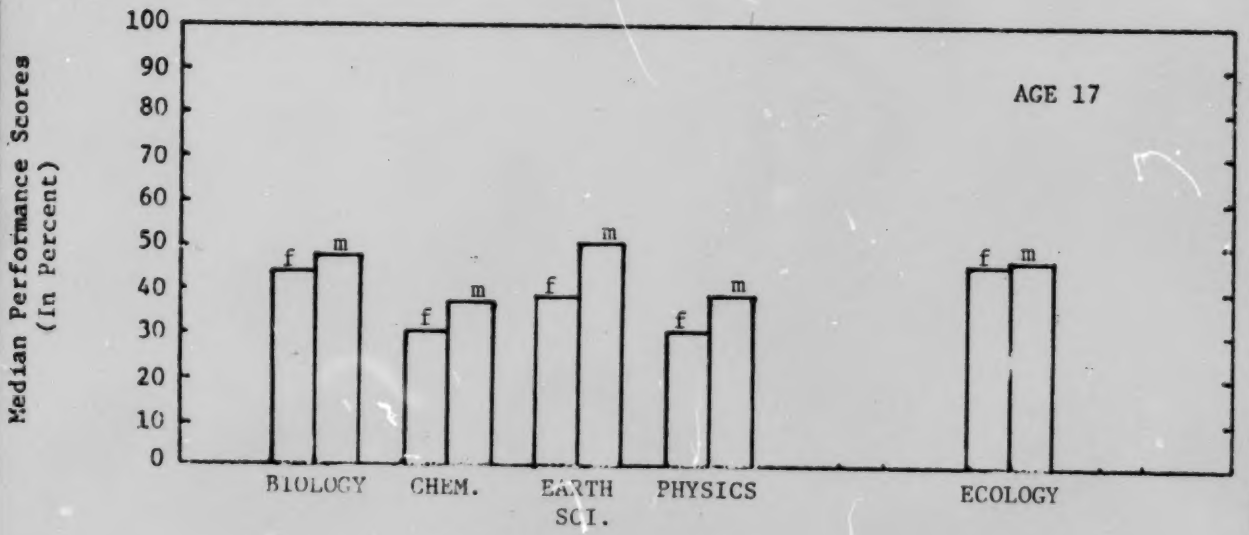


Table 8 presents performance data for 9 and 17 year olds, based on items which were used in the National Assessment 1969-70 and 1972073 studies as well as in this year's Massachusetts Assessment. The table contains, for both Massachusetts and National data, male and female median differences from total sample performance. For example, the Massachusetts male total median-difference for 17 year olds is arrived at by taking the median performance of male Massachusetts students on 11 National Assessment items (i.e., 55%) and subtracting from that figure the total sample median (i.e., 53%) on these National Assessment items.

It can be seen that total sex differences in performance favoring males is greater for Massachusetts 9 year olds than for the National Assessment 1972-73 national sample. The major contributions to the large sex difference for 9 year olds are found among the earth science exercises. For male 17 year olds median sex differences are about the same as those of the National Assessment group. However, on the sample of physics items sex differences are much smaller for Massachusetts studetns than for National Assessment sample students. This is an interesting fact, since performance on physics items is strongly related to having taken courses in physics, and females are much less likely to have had this experience (females 27%, males 49%).

TABLE 8 MALE AND FEMALE PERFORMANCE DIFFERENCES FROM TOTAL SAMPLE FOR MASSACHUSETTS AND NATIONAL ASSESSMENT (1972-73) STUDENTS

9 YEAR OLD		MASSACHUSETTS			NATIONAL		
Science Content Areas	# Items	Total Sample Median	Male Diff.	Female Diff.	Total Sample Median	Male Diff.	Female Diff.
Biology	5	83	+3	-1	76	+1.7	-1.7
Chemistry	4	59.5	+1	-2.5	51	+1.9	-1.9
Earth Science	4	66	+6	-6	60.5	+3.9	-4.0
Physics	3	71	0	-1	65	+2.6	-2.6
Total	16	71	+3	-3.5	64	+2.0	-2.0

17 YEAR OLD		MASSACHUSETTS			NATIONAL		
Science Content Areas	# Items	Total Sample Median	Male Diff.	Female Diff.	Total Sample Median	Male Diff.	Female Diff.
Biology	5	56	0	0	55	+2.1	-1.9
Chemistry	3	53	+2	-2	51	+2.3	-2.4
Physics	3	39	+2	-1	41	+8.0	-7.1
Total	11	53	+2	-2	51	+2.3	-2.4

In a similar fashion the relationship between median student performance and family occupational status varies according to age and content area. Where differences occur they are strongest in favor of high family occupational statu over low. No relationship exists between family occupational status and median test performance for 9 year olds on biology or ecology exercises nor for 17 yea olds on earth science exercises.

Previous Experiences

Previous experience items include seeing science demonstrations outside of school, performing a science project outside of school, talking about science with parents or friends, being in a school that had a project to help improve the environment and participating in a project to help improve the environment. Participation in environmental projects is examined in the section dealing with the ecology measurements.

Seeing a science demonstration outside of school is strongly associated with the performance of 17 year olds in all science content areas. It is not related to 9 year old performance on biology or ecology exercises. Actually performing a science experiment outside of school is strongly related to achiev ment only for 17 year olds on the biology exercises.

Both 9 and 17 year olds who report some amount of discussion with parent or friends on scientific or environmental topics perform better than those wh say that they never hold such discussions. This relationship appears to be s stantially greater for 17 year olds than 9 year olds particularly in the cont areas of biology, chemistry and ecology.

Table 9 adds another dimension to the set of previous experience factors It displays median test performance by lab and/or course experience for 9 and 17 year olds in each content area. For both age groups, except for 17 year o in earth science and 9 year olds in physics, there is a rather strong differe tiation in performance between those having some experience and those having experience. The most clear cut relationship between amount of lab experience and success on test exercises appears for 17 year olds in the chemistry conte area.

Attitudes

The attitude items include degree of liking school, and the degree to wh a student views environmental problems as dangerous (discussed in the sectio dealing with the ecology measurements). Liking school is positively associa with successful performance on all five content areas for 17 year olds. The strongest relationship between liking school and performance occurs on the

TABLE 9

SCIENCE LABORATORY - COURSE EXPERIENCE
AND MEDIAN ITEM-PERFORMANCE (IN PERCENT)

17 YEAR OLD

	CONTENT AREA			
	BIOLOGY	CHEMISTRY	EARTH SCIENCE	PHYSICS
MASSACHUSETTS	43	35	44	34
LAB EXPERIENCE*				
TWO PERIODS/WK OR MORE	48	46	48	46
ONE PERIOD/WK	50	48	46	46
TWO PERIODS/MTH - HARDLY EVER	42	34	46	39
NEVER HAD COURSE	32	20	43	30

9 YEAR OLD

	CONTENT AREA			
	BIOLOGY	CHEMISTRY	EARTH SCIENCE	PHYSICS
MASSACHUSETTS	46	60	61	54
STUDENT EXPERIMENTS*				
ONCE/WEEK	48	61	65	54
ONCE/MONTH	50	68	64	59
FEW TIMES/YR.	48	64	64	56
NEVER	40	54	56	52

*EXPERIENCE PERCENTS DO NOT ALWAYS AVERAGE OUT TO EQUAL THE MASS. PERCENT BECAUSE OF DIFFERENT NUMBER OF PUPILS IN EACH CATEGORY AND BECAUSE SOME PUPILS IN THE TOTAL GROUP DID NOT INDICATE COURSE EXPERIENCE.

ecology items and the weakest relationship occurs on the earth science items. Except for the chemistry exercises, 9 year olds do not show the rather straight forward relationships between liking school and achievement that are visible in the 17 year old data.

III. ANALYSIS OF INDIVIDUAL CONTENT AREAS

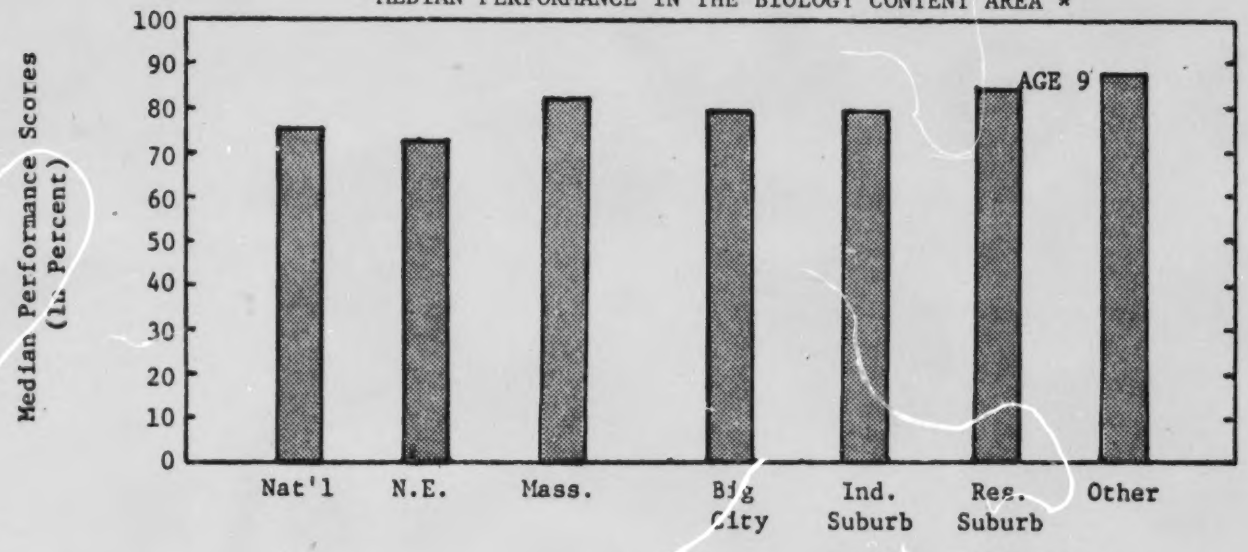
This section provides a description of the specific exercises used to measure students' performance in each content area, a presentation of the findings, and a discussion of the results. The performance of Massachusetts students is compared with the performance of students nationally and regionally, and on those National Assessment exercises for which data have been released. Where descriptive patterns are not reported this is because the general trends already outlined apply to the specific objective being discussed.

BIOLOGY

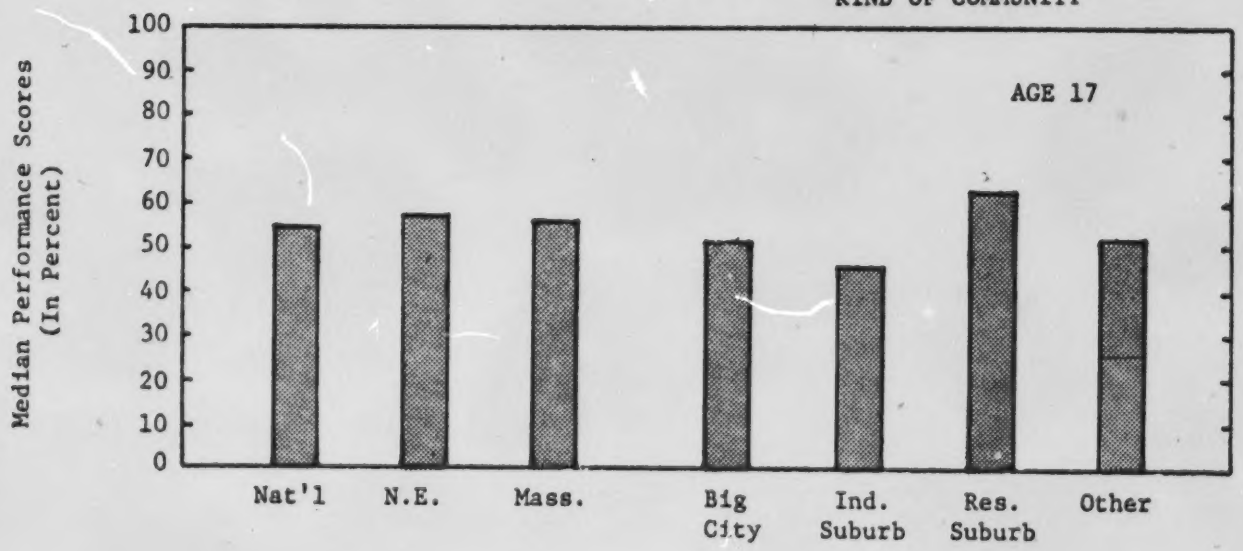
On the five biology exercises which were taken from the National Assessment study, Massachusetts 9 year olds (median percent - 83) significantly exceed the performance of both the National median percent - 76) and Northeast (median percent - 73) samples. For Massachusetts 17 year olds median performance (56%) is approximately equal to both the National sample median performance (55%) and the Northeast sample median performance (57%).

Biology test data show that males perform higher than females on biology items, and that the sex difference in performance is somewhat larger for 9 year olds. The 9 year old sex differences are most pronounced on items dealing

FIGURE 2
MEDIAN PERFORMANCE IN THE BIOLOGY CONTENT AREA *



*Comparable Items Only



with knowledge of disease carrying insects and functions of plant parts, and with understanding graphical presentation of information and the identification of a control error in a plant growing experiment. For 17 year olds the only rather large difference occurs on an item measuring the understanding of why mushrooms can be grown in the dark.

Although no association between median performance and family occupational status appears for 9 year olds, there is a pronounced association for 17 year olds where medium and high status students outperform low status students. Liking school has no apparent relationship to performance for 9 year olds but does present a significant relationship to performance for 17 year olds.

The experience of seeing science demonstrations outside of school is strongly related to median test performance for 17 year olds. Examples of exercises where this experience is related to significantly higher performance are knowing the essential characteristics of a mammal, identification of a vertibrate and understanding why mushrooms can be grown in the dark and explaining how fossils of shellfish could be discovered in the rocks of high mountains. Similarly, performing a science project outside of school is associated to about the same extent with median biology-exercise performance, and leads to success on the same types of items for 17 year olds.

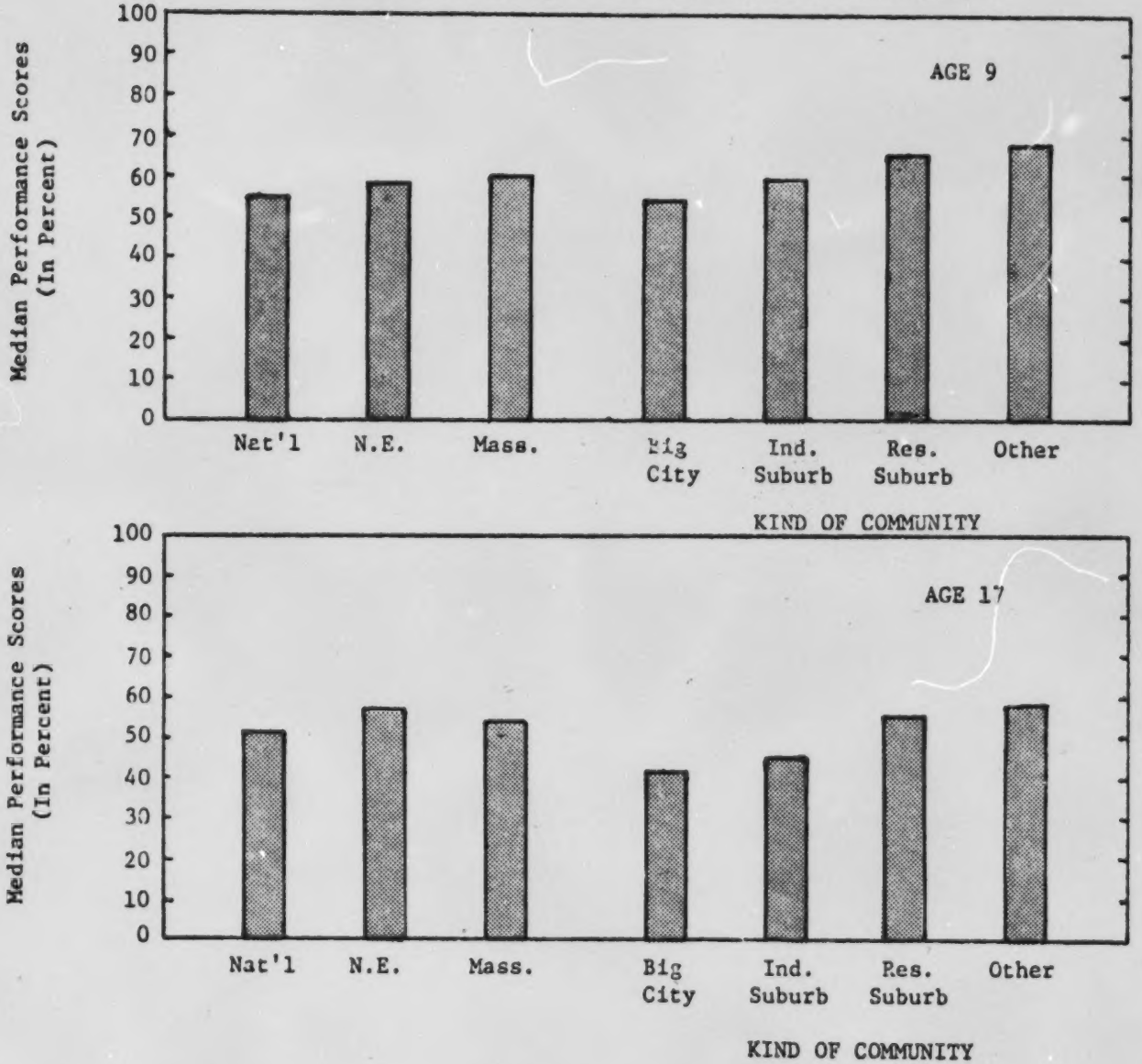
For 17 year old students, the reported frequency of science discussions with parents, and to a somewhat smaller extent friends, is associated with median test performance. Examples of items showing the strongest relationship are knowing the essential characteristics of a mammal, the structure that is most involved with the reproduction of the cell, explaining why giraffes have long necks by using the theory of natural selection, and understanding why mushrooms can be grown in the dark.

CHEMISTRY

On the five Chemistry exercises which were taken from the National Assessment study, Massachusetts 9 year olds (median percent - 60) exceed by a moderate amount the performance of both the National (median percent - 56) and the Northeast (median percent - 58) samples. For Massachusetts 17 year olds, the median performance (52) is approximately the same as the National sample median performance (51) but somewhat lower that the Northeast sample median performance (57).

Chemistry test data shows that 9 year old females perform somewhat higher than 9 year old males. However, on the 17 year old exercises males perform significantly higher than females. It is interesting to note that when sex differences do appear among 9 year old students they generally favor the females by small amounts. The one large exception is on an exercise that requires an

FIGURE 3
MEDIAN PERFORMANCE IN THE CHEMISTRY CONTENT AREA *



*Compar
Items

understanding of the cause of a fire increasing in intensity (i.e., males 83%, females 71%). For 17 year olds, five of the 9 chemistry exercises show the male female difference. These exercises include knowledge of which of several substances does not consist mainly of carbon atoms, understanding that when substances in a test tube react and give off gas the remaining contents have less weight, and understanding the reason why flour dust suspended in air can explode but a pile of grain will only burn slowly.

For three of the six 9 year old chemistry exercises, family occupational status is associated with performance. In each case the high status group perform significantly higher than the low status group. The three exercises involve understanding which substances will not dissolve in water, knowing a major factor in the rusting of iron and recognizing that vitamins are chemicals necessary for normal growth (not things that can be used instead of eating any food). Five of the nine chemistry exercises for 17 year olds show that the high status group performs higher than the low status group. The medium status group equals the high status group in performance on two of the five items, and also exceeds the low status group. Examples of the items showing these differences are recognizing an example of oxidation, identifying which of several substances does not consist mainly of carbon atoms and understanding the reason

why flour dust suspended in air can explode but a pile of grain will only burn slowly.

Liking school has a different relationship to performance for 9 year olds than for 17 year olds. For 9 year olds, students who respond that school is mostly OK or mostly not OK do better than those who like school very much, with those students disliking school very much doing the poorest. For 17 year olds those liking school very much and saying it is mostly OK do better than those who say it's mostly not OK or those that dislike it very much.

As with biology items, chemistry performance for 17 year olds is highly related to the experience of seeing science demonstrations outside of school. Although the strength of this association varies somewhat from item to item, all chemistry items for 17 year olds follow this trend. The strength of this relationship is considerably lower for the 9 year old group of students. For both age groups actually performing a science project outside of school is slightly related to performance.

For 9 year olds, talking about science with parents and friends are both related to performance. The group of students indicating any frequency at all fo this type of conversation does significantly better than those who say that they never do so. Two items fitting this trend deal with reading a table to

answer a question about which chemical in the body is present in the smallest amount and recognizing that vitamins are chemicals necessary for normal growth.

For 17 year olds the relationship between talking about science with parents and friends and test performance is higher than that for 9 year olds. Students reporting that they engage in such conversations once a week or more do better than those reporting "a few times a year" who in turn exceed those reporting that they never hold such conversations.

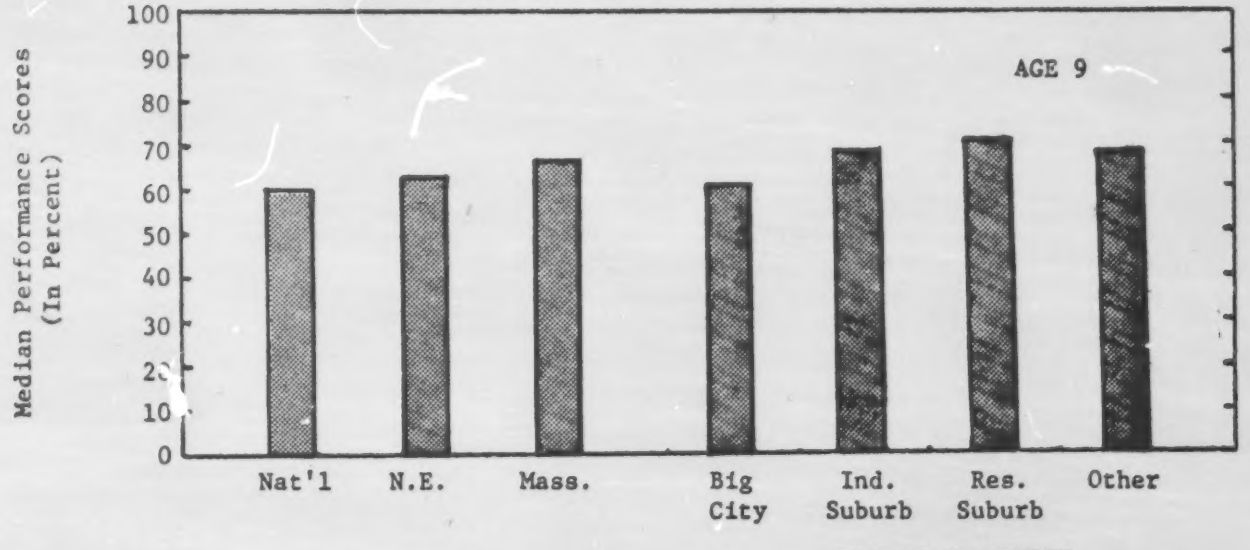
EARTH SCIENCE

In the content area of earth science, Massachusetts 9 year old students had four of their seven items selected from the National Assessment study. There were no earth science items selected from National Assessment for 17 year old students. The 9 year olds have a median performance level (66%) which exceeds both the National (60%) and the Northeast (62%) samples on these four items.

Earth Science exercise results show that for both 9 and 17 year olds males perform higher than females. This sex difference in performance is more pronounced for the 17 year olds. For 9 year olds the main items contributing to sex differences are knowing that each year the Earth moves around the Sun,

FIGURE 4

MEDIAN PERFORMANCE IN THE EARTH SCIENCE CONTENT AREA*



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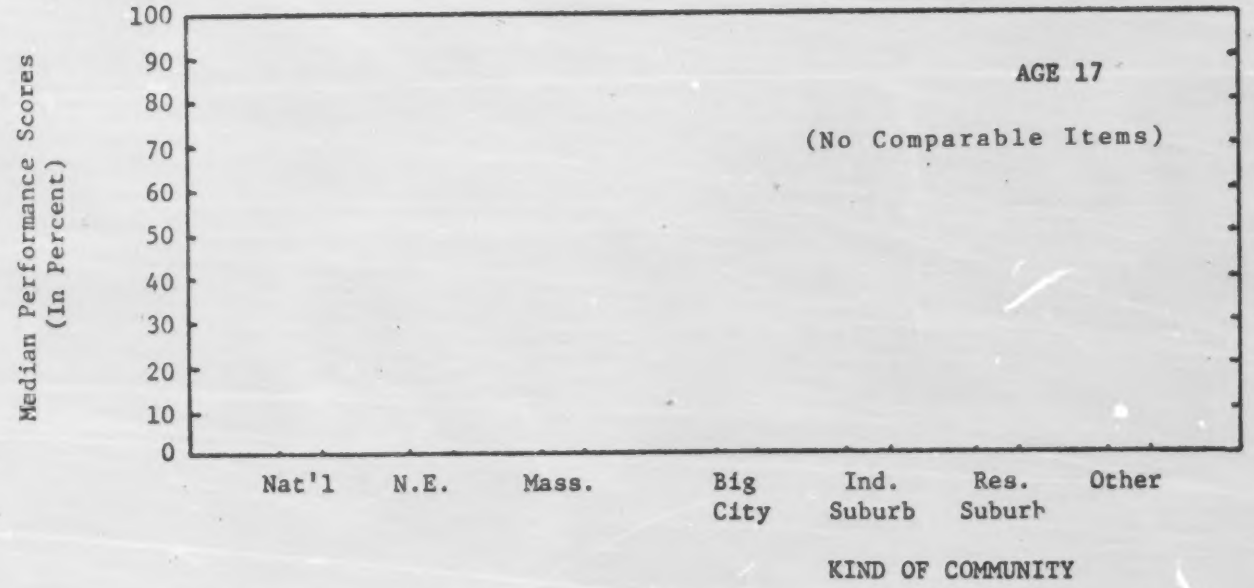
Items C



most of the Earth's surface is water, and understanding which of several diag represent the shadow of a tree at 12 noon. For 17 year olds, although sex differences exist on all four earth science items, the most pronounced differ ence (i.e., males 45%, females 28%) occurs on the exercise requiring an under standing of how long it would take us to know that the Sun suddenly stopped radiating light.

Although family occupational status has a relationship to median perfor- mance of the 9 year olds, it does not show any association with the performan of 17 year olds. One of the largest occupation status related exercises for 9 year olds (i.e., high 60, medium 56, low 43) requires the student to select a correct definition for the word "climate".

The degree of expression liking or disliking school is somewhat related to achievement for both 9 and 17 year old students. For 9 year olds the pat is that those who express a moderate amount of liking or disliking for schoo tend to perform higher than those who express a strong liking or disliking f school. Items illustrating this pattern are those requiring a knowledge of fact that most of the Earth's surface is water and understanding which of several diagrams represent the shadow of a tree at 12 noon. For 17 year old the one item which is mainly responsible for this pattern shows the "like ve

much" and "mostly OK" respondents performing significantly higher than the "mostly not OK" and "dislike very much" groups. This item requires an understanding of the responsibility of Earth's tilted axis for unequal lengths of day and night at different places on Earth.

There is a relationship between seeing a science demonstration or performi a science project outside of school and median performance on the earth science exercises. For 9 year olds the larger differences involve knowing that each ye the Earth moves around the Sun, selecting a correct definition for the word "climate" and selecting a phrase which describes an important characteristic of tropical lands. The largest component of this relationship for 17 year olds ca be attributed to the items dealing with the speed of light and the effect of Earth's tilted axis on length of day and night at different points on Earth.

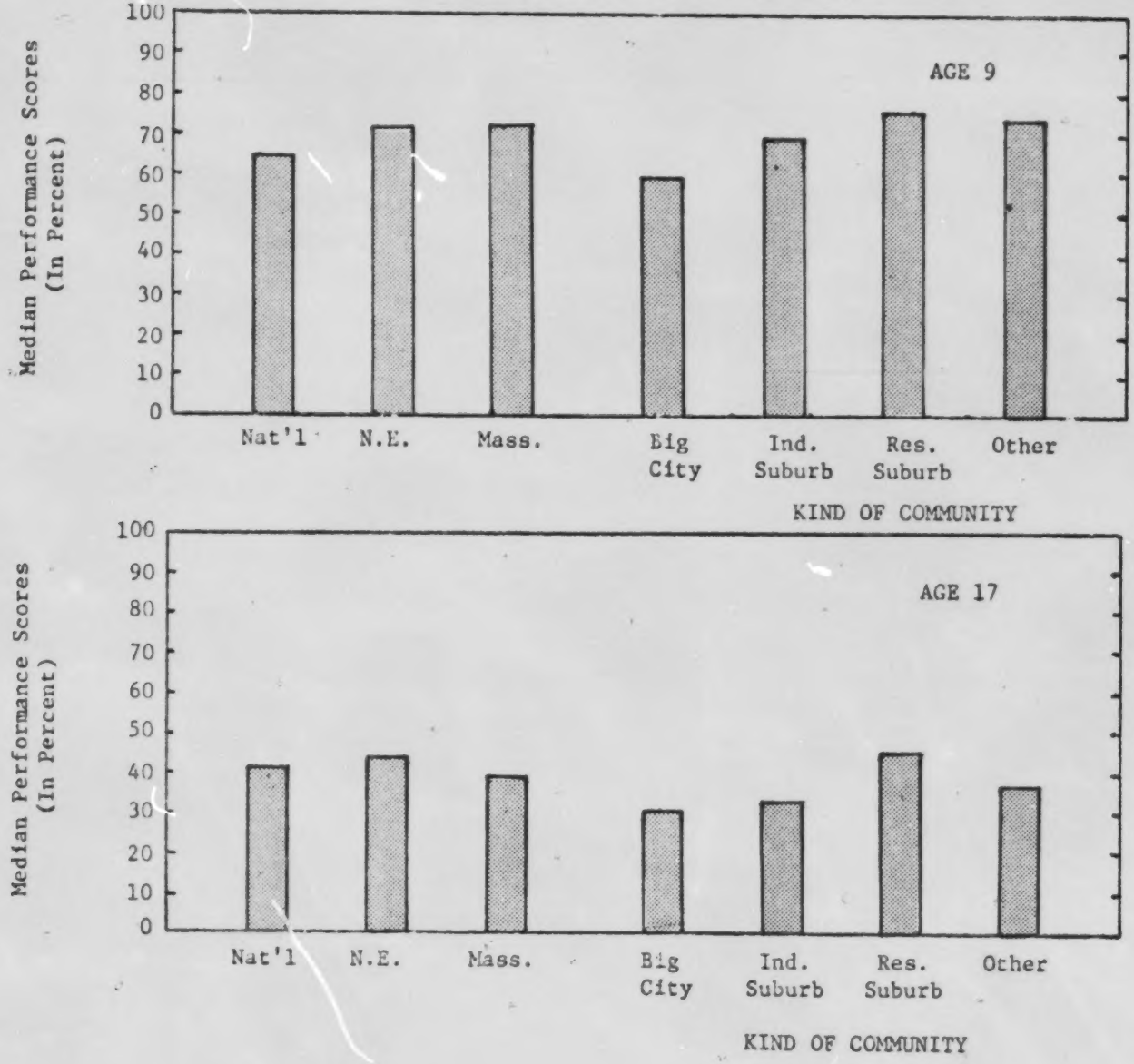
Talking about science with parents or friends is associated with level of performance on earth science items for both age groups. For 9 and 17 year olds any expression of these activities is related to higher median performance than if the student reports that he never engages in these activities. For 17 year olds the one item which does not show this relationship with either talking about science with parents or friends, is the one requiring an application of information about the speed of light.

PHYSICS

On the five physics exercises which were taken from the National Assessment study, Massachusetts 9 year olds (median percent - 71) perform equal to the Northeast sample (median percent - 71) and higher than National Sample (median percent - 65). Seventeen year old students (median percent - 39) perform somewhat lower than both the National Sample (median percent - 41) and the Northeast Sample (median percent - 43). A particularly strong relative performance for Massachusetts 9 year olds is on the item which deals with the cause of a rainbow. A relatively weak performance (i.e., compared to National and Northeast samples) is on the item which requires the student to recognize that with objects having the same volume the one that submerges the most in a liquid is the one that weighs the most. Even though the median performance of 17 year olds is somewhat below the National and Northeast samples (for the three National Assessment items) they perform relatively higher on the difficult item that requires an understanding of the constancy of mass of an object whether on the Earth or on the Moon.

Median sex differences do not exist for 9 year olds but do appear for 17 year olds. A notable exception to the lack of relationship between sex and performance for 9 year olds is on the item that requires the student to select a correct definition for a satellite (male 67%, female 55%).

FIGURE 5
MEDIAN PERFORMANCE IN THE PHYSICS CONTENT AREA



For 17 year olds statistically significant sex differences favoring males exist for 11 out of 14 items. No difference exists on the item requiring a knowledge of the fact that a refrigerator keeps its contents cool by transferring heat. Among the largest contributors to the sex difference - performance relationship is the exercise that requires the application of Ohm's law in deriving the resistance of an electric toaster.

There is a tendency for performance on physics items to be related to the magnitude of family occupational ststus for both 9 and 17 year old students. For 9 year olds examples of items contributing to this relationship are knowin that the unit of temperature is degrees, and understanding mirror image perspectives. For 17 year olds contributing items are knowing that the force between two charges varies inversely with the square of the distance between the charges and understanding that the bent appearance of a straw in a glass of water is attributed to the refraction of light.

Once again there is a tendency for 9 year olds expressing more moderate degrees of like and dislike for school to perform better than those who like school very much or dislike school very much. And for 17 year olds, the order of performance is "like school very much" being the highest, "mostly OK' and

"mostly not OK" next, and "dislike very much" the lowest. A strong contribution to the 9 year old pattern of relationship is the item that requires a student to recognize that the space taken up by a rock dropped into a pail of water can be measured by the amount of water that it displaces. For 17 year olds an item illustrating their pattern of relationship between degree of liking school and item performance, is one on which the correct response shows an understanding that the molecules of steam move more quickly than the molecules of ice.

The experience of seeing a science demonstration outside of school is related to higher median performance for both 9 and 17 year old students. There appears to be no association between doing some kind of science project outside of school and median physics performance. Two of the largest differences for 9 year olds are on items requiring the student to identify a function that a computer is incapable of doing, understand that breaking a rock into a greater number of pieces will not result in its displacing a greater volume of water. Performance on twelve of the fourteen items for 17 year olds exhibits the association between viewing outside science demonstrations and achieving higher. One of the larger differences occurs on the item where the correct response indicates an understanding that the molecules of steam move more quickly than the molecules of ice.

Inspecting the assessment results for both 9 and 17 year old students shows that talking with parents or friends about science is related to median performance. However, this relationship is noticeably stronger for 17 year olds than for 9 year olds. For 9 year olds the information item "All matter is made up of molecules" is among the largest contributors to this association. For 17 year olds the following three items exemplify strong contributions to this relationship: information that a refrigerator keeps its contents cool by transferring heat; understanding that the mass of a object does not change when moved from Earth to the Moon; understanding that the molecules of steam move more quickly than the molecules of ice.

Appreciation of Science

Within a series of items (for both 9 and 17 year old students) which are unclassified as to science content area, there are several "appreciation" items. These items measure the degree to which students value the objects, ideas, and processes of science. For 9 year olds two of these items have been taken from the National Assessment item collection. For 17 year olds, three of these items come from the National Assessment item collection.

Nine year old Massachusetts students have appreciation scores at about the same level (median percent = 65) as both the National (median percent = 64) and the Northeast (median percent 64) Samples. Seventeen year old Massachusetts students have appreciation scores somewhat lower (median percent = 60) than both the National (median percent =64) and the Northeast (median percent = samples. Although a somewhat greater percentage of Massachusetts 17 year olds want to become scientists (Massachusetts = 13%, National = 9%, Northeast = 7%) they disagree to a lesser extent with a statement implyint that the methods of science are of little help to the everyday problems of people (Massachusetts = 60%, National = 64%, Northeast = 63%) and they do not report quite as high a level of enjoyment at learning about new developments resulting from science (Massachusetts = 69%, National = 71%, Northeast = 72%).

Significant differences in appreciation appear in relation to Kind of Community, sex, liking school, seeing and/or performing science demonstrations outside of school, and talking with parents and/or friends about science.

For 9 year olds, those from Residential Suburbs have higher levels of science appreciation than those from the Big City. For 17 year olds, students from Residential Suburbs and Other Communities both have higher levels of science appreciation than those from Industrial Suburbs and Big Cities.

Sex differences, although small, are in favor of males. These differences are of the same magnitude for both 9 and 17 year olds.

Occupational Status differences exist in favor of high over low groups for the appreciation of science. This difference is about the same for both and 17 year old groups.

If a student reports that he or she has seen a science demonstration or performed a science project outside of school they are more likely to have a hig level of appreciation of science. These relationships are considerably stronger for the 17 year old students and particularly so for the experience "seeing outside science demonstrations".

When a student indicates that he talks about science with parents and/or friends, he is more likely to have a high level of science appreciation. For 9 year olds this difference exists mostly between those who report any amount of conversation versus those who report none of this conversation. However, for 17 year olds reporting conversation "once a week or more" have a median appreciation score of 77, "a few times a year" an appreciation score of 65, and "never" and appreciation score of 45.

Science Vocabulary and Children's TV Programs

For three hours on two consecutive Saturday mornings, TESCO research analysts recorded science terminology from children's shows on the three major networks. The recordings included both program and commercial content. Following these recordings a frequency analysis of the data yielded a list of most commonly used science terminology. From this list a set of nine items was added to the assessment instrument for 9 year olds. The student was requested to select a definition or major characteristic of each of the nine terms.

Several items which appear quite frequently on Saturday morning TV programs are a source of confusion to Massachusetts 9 year olds. Twenty-six percent of the students think that vitamins can be used instead of eating any food. A full 70% cannot go beyond the words "super-strong" in knowing the meaning of the word bionic. In addition, probably because of the characteristics of computers in cartoons, only 32% of the students know that a computer is not a machine that thinks by itself the same way that a person does.

Ecology

Student Involvement

Table 10 indicates that 37% of 9 year olds and 52% of 17 year olds are in schools that have had projects designed to improve the environment. For those 17 year olds selecting one of the five suggested stimuli for project involvement, friends, schoolwork and own ideas account for all but six percent of students participation. A somewhat larger number of 9 year olds than 17 year olds identify family, schoolwork and the media as the source of their participation in various environmental projects. More 17 year olds (34%) than 9 year olds (26%) say that they were not able to help in any projects. In addition, for 17 year olds, 20% report that they don't have the time to become involved and 7% say that they are really not interested in environmental problems.

Student Attitudes

Age comparison data on attitudes toward the seriousness of environmental problems, and areas in which students would be willing to make helpful alterations in their lifestyle appear in Table 11. About one in four 9 year old and 17 year old students believe that environmental problems are very dangerous. While only 5% of 17 year olds believe that these problems are not dangerous at all. almost one in five 9 year olds holds this belief.

In terms of lifestyle adjustment, 9 year olds and 17 year olds are most willing to perform a chore such as "collecting and returning bottles, cans and papers for reuse" (72% and 81%). Near the lowest endorsement for both groups was the item "eat one meal less each day" (9 year old - 22%; 17 year old - 38%). Seventeen year olds are more willing to do most of the suggested lifestyle modifications with the exceptions of "drive less in cars" (9 year old - 62%; 17 year old - 56%) and "make fewer visits to friends who live far away" (9 year old - 60%; 17 year old 60%).

Although the 17 year olds do have a consistantly higher reported willingness to alter their lifestyle, the percentages may be somewhat inflated. This supposition is based on the responses to the item concerned with using after school time to learn and do more about environmental problems. Nine year olds have a positive response to this item (i.e., 53%) generally in line with their responses to other items. Conversely, the 17 year old response to this item is the lowest (i.e., 32%) of all questions.

Two items from the attitude section of the assessment instrument provide an interesting insight into 17 year old attitudes towards a current ecological controversy. When questioned "Do you think that nuclear reactors can provide safe electrical power?", 32% respond yes, 20% no and 45% no opinion. However,

TABLE 10 PARTICIPATION OF 9 AND 17 YEAR OLD STUDENTS IN ECOLOGY PROJECTS

	9 YEAR OLDS	17 YEAR OL
HAS YOUR SCHOOL EVER HAD ANY SPECIAL PROJECTS TO IMPROVE THE ENVIRONMENT (SUCH AS COLLECTING BOTTLES, CANS OR PAPER TO BE USED AGAIN)?		
YES	37	52
IF YOU HAVE EVER HELPED IN ANY SPECIAL PROJECT TO IMPROVE THE ENVIRONMENT, WHY DID YOU DO IT? CHOOSE THE MOST IMPORTANT REASON.		
SOMEBODY IN MY FAMILY SUGGESTED IT	9	3
MY FRIENDS WERE DOING IT	13	16
IT WAS PART OF MY SCHOOL WORK	19	13
I GOT THE IDEA ON MY OWN	21	17
I GOT THE IDEA FROM RADIO, TV OR A MAGAZINE	8	3
I HAVE NOT BEEN ABLE TO HELP IN ANY PROJECTS	26	34

TABLE 11 ECOLOGY ATTITUDES OF 9 AND 17 YEAR OLD STUDENTS

	9 YEAR OLD	17 YEA
I THINK THAT MOST ENVIRONMENTAL PROBLEMS THAT WE HEAR ABOUT ARE:		
VERY DANGEROUS	25	
SOMEWHAT DANGEROUS	54	
NOT DANGEROUS AT ALL	19	

IF YOU WERE TOLD THAT THERE WERE LIMITED SUPPLIES OF FOOD, ENERGY AND MANY MATERIALS ON EARTH, AND YOU WERE ASKED TO CHANGE THE WAY THAT YOU LIVE, WHAT WOULD YOU BE WILLING TO DO?

	% YES	%
LIVE IN A SMALLER HOUSE	31	
DRINK LESS SODA BECAUSE IT COMES IN BOTTLES OR CANS	47	
STOP WATCHING TV	25	
WASH MY CLOTHES BY HAND	35	
DRIVE LESS IN CARS	62	
HAVE FEWER CLOTHES	22	
BE COLDER IN THE WINTER (USE LESS HEAT IN HOME AND SCHOOL)	30	
BE HOTTER IN THE SUMMER (USE LESS AIR-CONDITIONING)	50	
EAT LESS MEAT	31	
EAT ONE MEAL LESS EACH DAY	22	
MAKE FEWER VISITS TO FRIENDS WHO LIVE FAR AWAY	60	
COLLECT AND RETURN BOTTLES, CANS AND PAPERS FOR REUSE	72	
USE MY AFTER SCHOOL TIME TO LEARN AND DO MORE ABOUT ENVIRONMENTAL PROBLEMS ON OUR PLANET	53	

when subsequently asked "If I knew that there would be long periods of time without electricity, I would support the use of nuclear power.", 57% responded yes, 13% no, and 27% no opinion. Apparently, even a third of those who do not believe that nuclear energy can safely provide electrical power will endorse it if they believe that electrical shortage would be the alternative.

Student Achievement

Massachusetts 9 year old students perform at a median level of 62% with the most difficult item requiring the student to recognize a food chain (13%) and the easiest item requiring the student to recognize that plants provide food for many varieties of living organisms. The 17 year old students perform at a median level of 48% with the most difficult item requiring the identification of a primary consumer in a food chain (17%) and the easiest item requiring the information that a difference between man and other living things is that he changes his environment.

There are no sex differences in median performance for either 9 or 17 year old Massachusetts studetns. There are some individual items which are exceptions to that trend. For 9 year olds, males are more able to identify the kind of environment in which one would find a bird having webbed feet while females are more likely to recognize that it's possible to harm nature to

such a degree that it cannot recover. For 17 year olds a rather large sex difference in performance in favor of males appears on an item which requires an understanding of the relationship between the existence of predators and the population size of their prey (males 60%; females 45%).

No relationship exists between median test performance and family occupational status for 9 year olds. An exception to this finding is on an exercise which requires the student to recognize a food chain. High and Medium status students perform better than low status students. There does exist for 17 year old students a relationship between median test score performance and family occupational status with high status students performing the best, and medium status students in many cases equal to the high status group and above the Low status group. An illustrative item where performance patterns follow this trend is one that requires the identification of the organism in a food chain responsible for the conversion of light energy into other usable forms.

Although there is a strong relationship between the expressed degree of liking school and median performance for 17 year old students, 9 year olds do not exhibit the same trend. An item which follows this pattern for 17 year olds is the same example (i.e., organism in food chain which converts light

energy) that was related to occupational status for these students.

Students in both age groups who report some conversations about the environment with parents and/or friends have a median performance higher than those who say that they never hold such conversations. However, the strength of this trend is much greater for 17 year old students. For 9 year olds the two items which best illustrate this association require an understanding of the relationship between physical characteristics of animals and the environment in which they live, and an appreciation of the fact that everyone can have an impact in changing the environment. The items characteristic of this strong association for 17 year old students include knowing that man differs from other living things in the power to make changes in his environment and understanding the relationship between the existence of predators and the population size of their prey.

The fact that a school had a project to help the environment or that a student participated in this project is unrelated to achievement in ecology exercises for 9 year old students. On the other hand, there is a moderate relationship between these two factors and achievement for 17 year old students The largest difference favoring those who were in a school having such a project or participating in such a project is for an ecology appreciation item

where the student must not accept or reject a proposed coal burning plant until he has information on its environmental impact.

One of the most interesting relationships is between the student's feelings concerning the danger level of environmental problems and his achievement on ecology items. For 9 year old students, those who feel that environmental problems are somewhat dangerous have a higher median performance than both those who feel that the problems are very dangerous and those who feel that the problems are not dangerous at all. However, the 17 year old students show a different trend. The more dangerous they feel the environmental problems are, the higher their median performance. This pattern holds for most of knowledge and understanding items which contribute to this trend. The major exception is on the appreciation item dealing with the evaluation of the coal burning plant. The "environmental problems are somewhat dangerous" group is much more likely to take the tempered "first determine the effect on the environment" approach than either the "very dangerous" or "not at all dangerous" groups.

TABLE 12

SAMPLE COMPOSITION
(IN PERCENT)

Characteristics	Age 9	Age 17
Total Sample Size	1,778	1,757
Region		
Boston	32	21
Northeast	21	20
Pittsfield	2	4
Southeast	18	20
Springfield	10	11
Worcester	15	24
Kind of Community		
Big City	26	16
Industrial Suburb	19	9
Residentail Suburb	19	39
Other	35	36
Sex		
Female	48	47
Male	51	50
Occupation of Household Head		
Professional, Bus. Owner, Manager	45	50
Skilled, Blue Collar, Salesman	23	30
Unskilled	7	8

TABLE 12

SAMPLE COMPOSITION
(IN PERCENT) (CONTINUED)

Characteristics	Age 9	Age 17
Attitude Toward School		
Like Very Much	23	10
Mostly OK	52	67
Mostly Not OK	13	15
Don't Like At All	11	6

V. MULTIPLE REGRESSION ANALYSES

This section allows the reader to more accurately determine the major correlates of student achievement in science and ecology. Although it is useful to examine the tables that indicate the simple correlations of student characteristics and background experiences with achievement, it is also difficult to grasp a simple interpretation of these data. Since characteristics and experience are related not only to achievement but also to one another (to varying degrees), the most important set of variables cannot be identified by visual inspection of such a table.

Multiple regression analysis allows a parsimonious interpretation of these many relationships. This procedure begins by selecting the variable that has the highest correlation with achievement and adding a second that produces the highest increase in correlation with achievement. That is, succeeding variables are added in order of their correlation with achievement and their lack of overlap (i.e., correlation) with those already selected. In most educational studies diminishing returns soon set in and new variables make very small additions in the multiple correlations.

As one can see in Table 14, from the row labelled "last", there is a rather large association between the set of student characteristics and background variables for 17 year olds with science and ecology achievement. The predictive power of these

variables with achievement variables ranges from a low of 21% (i.e., $.46^2$) for earth science achievement to a high of 41% (i.e., $.64^2$) for the total of all achievement areas. This means that for overall achievement of 17 year old students 41% of what constitutes individual differences can be accounted for (i.e., predicted) from this set of variables.

The data for 9 year old students indicates a very weak relationship between characteristics and background variables with science and ecology achievement. The entire set of variables yields a multiple correlation which only permits accounting for 9% of individual difference in total achievement. Individual content areas are even less well predicted, with ecology being at 4%.

Table 14 also shows that three of the seventeen variables for 17 year olds account for most of the predictive power in all content areas. Those variables are amount of physics laboratory experience, amount of chemistry laboratory experience, and talking about science with friends outside of school.

It is important to note that since this is a correlational study and not a longitudinal experiment, one cannot unequivocally conclude that these experiences produce better achievers. Part of the relationship may be due to the fact that students who are superior to begin with are channeled into and seek out such experience.

TABLE 13
(Part A)

Simple Correlations of Nine Year Old Student Characteristics and Background Experience with Science & Ecology Achievement

	Content Area					
	Bio.	Chem.	Earth Science	Ecology	Physics	Total
1. Time on Science Experiments	.01	.05	.01	.04	.02	.03
2. Parental Occupational Status	.16	.11	.10	.12	.08	.16
3. Sex	.18	.03	.13	.05	.09	.13
4. Talks about science with friends*	.04	.09	.06	.06	.01	.08
5. Talks about science with parents	.03	.01	.11	.07	.02	.07
6. Seen science demonstrations*	.08	.05	.09	.07	.11	.10
7. Performed science project*	.05	.01	.03	.09	.03	.03
8. Talks about environment with friends*	.04	.08	.06	.06	.01	.07
9. Talks about environment with parents	.03	.05	.11	.07	.02	.06
10. School had environmental projects	.07	.01	.01	.03	.02	.02
11. Joined environmental projects	.00	.01	.03	.06	.01	.04
12. Feelings about school	.12	.02	.04	.02	.05	.03
13. Science supervisor in school	.02	.03	.00	.02	.01	.00
14. Specific science teacher	.01	.07	.04	.04	.04	.00
15. Science hours/week	.01	.01	.02	.07	.08	.00
16. Principal prefers more science	.08	.10	.14	.00	.12	.11
17. Ecology at 3rd or 4th grade	.00	.02	.03	.03	.03	.03

*Outside of school
13 - 14 are variables for the students' school

TABLE 13
(Part B)

Simple Correlations of Seventeen Year Old Student Characteristics and Background Experience with Science & Ecology Achievement

		Content Area					
		Bio.	Chem.	Earth Science	Ecology	Physics	Total
1.	Amt. of Bio. Lab Experience	.04	.14	.05	.11	.13	.14
2.	Amt. of Chem. Lab Experience	.34	.34	.28	.36	.34	.44
3.	Amt. of Earth Science Lab Experience	.01	.02	.04	.03	.02	.01
4.	Amt. of Physics Lab Experience	.31	.34	.29	.37	.33	.42
5.	Parents Occupational Status	.20	.19	.14	.18	.14	.22
6.	Sex	.16	.07	.17	.25	.12	.21
7.	Talks about science with friends*	.29	.33	.28	.33	.33	.40
8.	Talks about science with parents	.26	.29	.20	.29	.29	.34
9.	Seen science demonstration*	.17	.14	.14	.22	.26	.23
10.	Performed science projects*	.06	.09	.03	.13	.12	.11
11.	Talks about environment with friends*	.06	.11	.11	.07	.18	.13
12.	Talks about environment with parents	.14	.22	.11	.16	.23	.23
13.	School had environmental projects	.07	.07	.03	.07	.04	.08
14.	Joined environmental projects	.04	.07	.04	.00	.03	.05
15.	Hours studying ecology	.00	.04	.09	.03	.02	.00
16.	School has separate ecology course	.02	.10	.06	.01	.01	.02
17.	School has ecology within other courses	.04	.01	.04	.02	.01	.02

*Outside of school
16 - 17 are variables for the students' school

TABLE 14

Step-Wise Multiple Correlations of Seventeen Year Old Student Characteristics and Background Experience with Science & Ecology Achievement*

Biology		Chemistry		Earth Science		Ecology		Physics		Total	
Var.	Multiple R	Var.	Multiple R	Var.	Multiple R	Var.	Multiple R	Var.	Multiple R	Var.	Multiple R
2	.34	4	.34	4	.29	4	.37	2	.34	2	.44
4	.40	7	.44	7	.38	7	.46	4	.41	4	.53
7	.43	2	.48	2	.40	6	.50	7	.46	7	.59
6	.45			6	.42	2	.53	9	.48		
.											
.											
.											
last	.49	last	.52	last	.46	last	.57	last	.51	last	.64

*The multiple correlations are printed up to the point where adding a variable produces only a .01 gain or less. Then the multiple correlates for the total set of variables is printed (i.e., last). No Step-Wise data appear for nine year olds since all content area multiple R's for the 17 variables were less than .30.

VI. ADMINISTRATION PROCEDURES

Field administration of the 1976-77 Massachusetts Educational Assessment Program was managed jointly by TESCO and the Massachusetts Department of Education. These management functions included the hiring, training and supervision of field administrators. All field administrators (eleven) had teaching experience and most had participated in prior Massachusetts Assessment testing.

An all day training session for test administrators was held in early November. Participants were trained in the procedures of making school contacts, selecting the random student sample, setting up the testing room, arranging test materials, operation of the tape player, collection of school information forms from the principals and packaging and returning test materials. Taped test directions were played for the administrators to insure their functioning with this standardized testing procedure.

On a given test day in a school the sample of students were assembled and the field administrator verified the attendance, briefly explained the purposes or the assessment program, and distributed the test booklets. An audio tape recited each test item and the options for responses. Although most schools were tested prior to the Christmas recess, snow days required the January testing of six of the schools. During the field testing period a representative of the Massachusetts Department of Education made random visits to some of the test sessions to verify that the correct proce-

dures were being used and to insure that total anonymity was maintained

VII. CURRENT AND GEOGRAPHICALLY RELEVANT ITEM SOURCES

During the period of September 20 - October 4, 1976, TESCO researchers explored four current and geographically relevant sources as a basis for item content. The sources were:

1) six newspapers from around the state
2) three major weekly news magazines
3) the three major network's prime-time news broadcasts
4) the three network's Saturday morning children's shows

During this period of time all consumer and ecology vocabulary and phrases were recorded. Commercials and advertisements were included in these recordings. A content analysis was then undertaken to identify the most frequently used terms and concepts for inclusion in both the ecology and consumer instruments.

FIGURE 6

MASSACHUSETTS NEWSPAPERS AND NATIONAL NEWS MAGAZINES
USED AS ITEM CONTENT SOURCES

New Bedford Standard Times
Boston Globe
Lawrence Eagle-Tribune
Boston Herald-American
Berkshire Eagle
Worcester Telegram

Time
Newsweek
U.S. News and World Reports

VIII. DETAILED RESULTS

The results of Science and Ecology measurements for Massachusetts students are shown in detail in this section. Figure 7 lists the Kind of Community classification of each school district in the Commonwealth. Following this, there are twelve tables, one for each of the six science areas (Biology, Chemistry, Earth Science, Ecology, Physics and Unclassified) and one for each age group (9 and 17 year olds). Each table shows the Massachusetts median score for each content area, and the National Assessment median score for the U.S. and for the Northeast, as well as the International Study of Science median (percentages are not presented when the item was not included in the National or International studies). The main body of the table shows the percent of students who got the item correct for each demographic sub-group.

Following each table there is a reproduction of the pages of the test booklets. These reproductions contain the percentage of students giving each of the possible answers, including the correct one which is identified by a darkened circle. The percentages may not add to 100 since the percent who did not answer is not shown.

FIGURE 7

IDENTIFICATION OF KIND OF COMMUNITY (KOC)* FOR MASSACHUSETTS SCHOOL DISTRICTS

KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM
3	Abington	4	Bernardston Union 18	2	Chelsea
3	Acton	3	Beverly	4	Chesterfield Union 66
4	Acushnet	4	Billerica	1	Chicopee
4	Agawam	4	Blackstone Union 44	4	Chilmark Union 19
4	Amesbury	4	Bolton Union 47	4	Clarksburg Union 43
3	Amherst Union 26	1	Boston	4	Clinton
3	Andover	4	Bourne Union 10	3	Cohasset
3	Arlington	4	Boxborough Union 42	3	Concord
4	Ashburnham Union 56	3	Boxford Union 58	4	Conway Union 38
4	Ashfield Union 65	3	Boylston Union 60	3	Danvers
3	Ashland	3	Braintree	4	Dartmouth
4	Athol	4	Brewster Union 54	3	Dedham
4	Attleboro	4	Bridgewater	4	Deerfield Union 38
2	Auburn	4	Brimfield Union 61	4	Dennis Union 11
3	Avon	1	Brockton	4	Dighton Union 37
4	Ayer	4	Brookfield Union 61	4	Douglas
4	Barnstable	3	Brookline	3	Dover Union 50
4	Barre Union 63	3	Burlington	4	Dracut
3	Bedford	2	Cambridge	4	Dunstable Union 46
4	Belchertown	3	Canton	3	Duxbury
4	Bellingham	3	Carlisle	4	East Bridgewater
3	Belmont	4	Carver Union 62	4	East Brookfield Union 7
4	Berkley Union 37	4	Chatham	4	Eastham Union 54
4	Berlin Union 60	3	Chelmsford	2	Easthampton

*KOC Definitions: 1 = Big city; 2 = Industrial suburb; 3 = Residential suburb; 4 = Other

FIGURE 7 (CONT'D.)

KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM
3	East Longmeadow	4	Greenfield	3	Hudson
3	Easton	3	Groton Union 46	3	Hull
4	Edgartown Union 19	4	Groveland Union 53	4	Ipswich
4	Erving Union 28	4	Hadley	4	Kingston Union 31
4	Essex Union 48	4	Halifax Union 31	4	Lakeville Union 34
2	Everett	3	Hamilton Union 57	4	Lancaster
4	Fairhaven	4	Hampden	4	Lanesborough Union 6
1	Fall River	4	Hancock Union 69	1	Lawrence
4	Falmouth	3	Hanover	2	Lee Union 29
1	Fitchburg	4	Hanson	4	Leicester
4	Florida Union 43	4	Hardwick Union 63	4	Lenox
3	Foxborough	4	Harvard	1	Leominster
3	Framingham	4	Harwich	4	Leverett Union 28
4	Franklin	4	Hatfield	3	Lexington
4	Freetown Union 34	1	Haverhill	4	Leyden Union 18
4	Gardner	3	Hingham	3	Lincoln
4	Georgetown	3	Holbrook	3	Littleton
4	Gill Union 18	3	Holden Union 64	3	Longmeadow
4	Gloucester	4	Holland Union 61	1	Lowell
4	Goshen Union 66	3	Holliston	4	Ludlow
4	Gosnold Union 37	1	Holyoke	4	Lunenburg
3	Grafton	4	Hopedale	2	Lynn
4	Granby	3	Hopkinton	3	Lynnfield
4	Granville Union 39	4	Hubbardston Union 63	2	Malden

*KOC Definitions: 1 = Big City; 2 = Industrial suburb; 3 = Residential suburb; 4 = Other

FIGURE 7 (CONT'D.)

KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM
3	Manchester Union 48	4	Montague	4	Oak Bluffs Union 19
4	Mansfield	3	Nahant	4	Oakham Union 63
3	Marblehead	4	Nantucket	4	Orange
4	Marion Union 55	3	Natick	4	Orleans Union 54
4	Marlborough	3	Needham	4	Otis Union 29
3	Marshfield	1	New Bedford	4	Oxford
4	Mashpee Union 10	4	New Braintree Union 12	4	Palmer
4	Mattapoisett Union 55	3	Newbury Union 68	3	Paxton Union 64
4	Maynard	4	Newburyport	2	Peabody
3	Medfield	4	New Salem Union 28	4	Pelham Union 26
2	Medford	3	Newton	3	Pembroke Union 31
4	Medway	3	Norfolk	4	Petersham
3	Melrose	4	North Adams	4	Phillipston Union 1
4	Merrimac Union 53	4	Northampton	1	Pittsfield
4	Methuen	3	North Andover	4	Plainville
4	Middleborough	4	North Attleboro	4	Plymouth Union 62
3	Middleton	3	Northborough Union 3	4	Plympton Union 31
4	Milford	4	Northbridge	4	Princeton Union 64
2	Millbury	4	North Brookfield Union 7	4	Provincetown Union 1
3	Millis	4	Northfield Union 18	2	Quincy
4	Millville Union 44	3	North Reading	3	Randolph
3	Milton	4	Norton	3	Raynham
4	Monroe Union 43	3	Norwell	3	Reading
2	Monson	3	Norwood	4	Rehoboth Union 37

*KOC Definitions: 1 = Big city; 2 = Industrial suburb; 3 = Residential suburb; 4 = Other

FIGURE 7 (CONT'D.)

KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM
2	Revere	4	Southampton Union 66	4	Tyringham Union 29
4	Richmond Union 69	3	Southborough Union 3	4	Uxbridge
4	Rochester Union 55	4	Southbridge	3	Wakefield
3	Rockland	4	South Hadley	4	Wales Union 61
3	Rockport	4	Southwick Union 39	3	Walpole
4	Rowe Union 65	4	Spencer	2	Waltham
4	Rowley Union 68	1	Springfield	4	Ware
4	Royalston Union 1	4	Sterling Union 64	4	Wareham
4	Rutland Union 64	3	Stoneham	2	Warren Union 12
2	Salem	4	Stoughton	4	Warwick Union 18
4	Salisbury Union 68	3	Stow Union 47	2	Watertown
4	Sandisfield Union 39	3	Sturbridge Union 61	3	Wayland
4	Sandwich Union 10	3	Sudbury	4	Webster
3	Saugus	4	Sunderland Union 38	3	Wellesley
4	Savoy Union 43	4	Sutton	4	Wellfleet Union 54
3	Scituate	3	Swampscott	4	Wendell Union 28
3	Seekonk	4	Swansea	3	Wenham Union 57
3	Sharon	4	Taunton	3	Westborough
3	Sherborn Union 50	3	Templeton Union 1	3	West Boylston
4	Shirley Union 42	3	Tewksbury	4	West Bridgewater
3	Shrewsbury	4	Tisbury Union 19	4	West Brookfield Union 12
4	Shutesbury Union 28	3	Topsfield Union 58	4	Westfield
4	Somerset	4	Truro Union 14	3	Westford
2	Somerville	4	Tyngsborough	4	Westhampton Union 66

*KOC Definitions: 1 = Big city; 2 = Industrial suburb; 3 = Residential suburb; 4 = Other

FIGURE 7 (CONT'D.)

KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM	KOC	SCHOOL SYSTEM
4	Westminster Union 56	4	Ashburnham-Westminster	4	Martha's Vineyard
4	West Newbury Union 53	4	Athol-Royalston	3	Masconomet
3	Weston	4	Berkshire Hills	4	Mendon-Upton
4	Westport	3	Berlin-Boylston	4	Mount Greylock
4	West Springfield	4	Blackstone-Millville	4	Mohawk Trail
4	West Tisbury Union 19	4	Bridgewater-Raynham	3	Narragansett
3	Westwood	4	Buckland-Shelburne	4	Nashoba
3	Weymouth	3	Central Berkshire	3	Northboro-Southboro
4	Whately Union 38	3	Concord-Carlisle	4	North Middlesex
4	Whitman	4	Dennis-Yarmouth	4	Old Rochester
3	Wilbraham	4	Dighton-Rehoboth	3	Pentucket
4	Williamsburg Union 66	3	Dover-Sherborn	4	Pioneer Valley
3	Williamstown	4	Dudley-Charlton Reg	4	Plymouth-Carver
3	Wilmington	4	Nauset	4	Quabbin
4	Winchendon	4	Freetown-Lakeville	4	Ralph C. Mahar
3	Winchester	4	Frontier	3	Silver Lake
3	Winthrop	4	Gateway	4	Southern Berkshire
3	Woburn	4	Gill-Montague	4	Spencer-E. Brookfiel
1	Worcester	3	Hamilton-Wenham	4	Tantasqua
3	Wrentham	3	Hampden-Wilbraham	4	Triton
4	Yarmouth Union 11	4	Hampshire	3	Wachusett
3	Acton-Boxborough	4	Hawlemont	2	Warren-W. Brookfield
4	Adams-Cheshire	3	King Philip	4	Whitman-Hanson
3	Amherst-Pelham	3	Lincoln-Sudbury	3	Assabet Valley

*KOC Definitions: 1 = Big city; 2 = Industrial suburb; 3 = Residential suburb; 4 = Other

FIGURE 7 (CONT'D.)

KOC	SCHOOL SYSTEM
4	Blackstone Valley Reg
3	Blue Hills Voc
4	Bristol-Plymouth Voc-Tech
1	Greater Fall River
1	Greater Lawrence
3	So. Middlesex Voc-Tech Reg
4	Montachusett Voc-Tech
4	Northern Berkshire Voc
3	Nashoba Valley Tech
3	Northeast Metro Voc
4	Pathfinder Voc-Tech
3	Shawsheen Valley Voc-Tech
1	Southeastern
3	South Shore Voc-Tech
4	S. Worcester County Voc
4	Upper Cape Cod Voc-Tech
4	Whittier Voc
4	Bristol County Agr.
4	Essex Agr. Tech
4	Norfolk County Agr.

TABLE 15 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT)
Science Content Area - Biology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE								UNDERSTANDING			
	Question Number	1	4	7	17	45	47	49	53	20	33	34	35
MASSACHUSETTS	46	95	41	83	93	48	1	17	43	49	42	31	56
NATIONAL		90	46	76	87					56			
NORTHEAST		89	39	73	89					58			
INTERNATIONAL STUDY											30	34	56
REGION													
BOSTON	46	97	43	82	91	49	0	16	37	48	45	29	52
NORTHEAST	48	95	33	85	95	50	0	18	47	49	40	32	60
PITTSFIELD	44	93	25	80	100	39	4	14	32	50	36	48	64
SOUTHEAST	46	98	43	85	92	47	2	16	43	49	44	30	56
SPRINGFIELD	50	97	47	82	94	48	2	24	56	52	39	35	60
WORCESTER	46	96	44	86	93	48	1	18	45	51	40	34	52
KIND OF COMMUNITY													
BIG CITY	42	96	36	80	87	42	1	19	43	46	38	27	55
INDUSTRIAL SUB	42	96	32	80	92	45	1	8	31	41	44	27	51
RESIDENTIAL SUB	52	98	47	86	97	54	0	13	46	56	49	35	58
OTHER	46	96	43	88	97	53	2	11	43	50	40	34	55
SEX													
FEMALE	42	96	37	82	92	44	0	15	41	46	38	30	56
MALE	49	97	45	86	94	53	1	13	45	52	46	33	55
FAMILY OCC. STATUS													
LOW	46	95	33	82	92	52	0	13	43	48	40	37	60
MEDIUM	48	98	42	82	93	49	1	8	42	48	42	29	54
HIGH	49	98	44	87	95	50	2	15	47	52	44	35	58
LIKE SCHOOL													
LIKE VERY MUCH	43	96	40	80	91	45	1	17	41	46	39	30	55
MOSTLY OK	48	98	42	86	94	50	1	12	45	50	42	32	57
MOSTLY NOT OK	49	96	36	83	94	52	1	12	37	50	48	36	54
DISLIKE VERY MUCH	46	94	45	80	93	43	0	16	44	48	46	27	54

TABLE 15 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Biology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE											
		KNOWLEDGE								UNDERSTANDING			
	Question Number	1	4	7	17	45	47	49	53	20	33	34	35
SEEN SCIENCE DEMO. OUTSIDE SCHOOL													
YES	48	97	44	85	94	50	1	13	47	54	45	35	58
NO	44	97	38	83	92	47	0	14	39	46	40	28	54
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL													
YES	47	97	44	85	96	49	1	13	45	52	45	32	58
NO	42	96	36	82	90	48	1	16	39	46	38	31	52
WORK ON EXPERIMENT IN YOUR CLASS													
ONCE A WEEK OR MORE	48	97	40	85	95	51	1	13	44	51	40	30	56
ONCE A MONTH	50	96	51	89	94	48	1	16	42	55	50	40	54
A FEW TIMES A YEAR	48	96	44	82	94	47	1	14	43	53	48	34	56
NEVER	40	96	35	82	89	46	1	15	39	42	38	28	55
TALK ABOUT SCIENCE WITH PARENTS													
ONCE A WEEK OR MORE	49	96	45	85	94	51	1	11	47	51	44	33	58
A FEW TIMES A YEAR	49	98	45	85	95	52	1	12	46	52	46	34	57
NEVER	42	96	36	83	91	45	1	17	38	47	39	29	53
TALK ABOUT ENVIRONMENT WITH PARENTS													
ONCE A WEEK OR MORE	48	97	43	85	95	51	1	10	45	50	42	31	56
A FEW TIMES A YEAR	48	97	44	86	94	50	2	17	45	50	46	32	59
NEVER	48	96	37	82	92	46	1	14	40	49	40	31	52

TABLE 15 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Biology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE								UNDERSTANDING			
	Question Number	1	4	7	17	45	47	49	53	20	33	34	35
TALK ABOUT SCIENCE WITH FRIENDS													
ONCE A WEEK OR MORE	48	97	43	86	94	50	1	13	46	54	47	30	55
A FEW TIMES A YEAR	49	96	46	86	94	52	2	12	45	53	40	36	56
NEVER	44	96	36	82	92	46	0	16	40	46	41	30	56
TALK ABOUT ENVIRONMENT WITH FRIENDS													
ONCE A WEEK OR MORE	48	97	45	85	93	53	2	14	46	51	37	32	58
A FEW TIMES A YEAR	49	96	45	87	97	48	2	12	47	54	50	35	56
NEVER	44	97	37	82	91	47	0	15	40	47	40	30	54
SCHOOL HAD HELP ENVIRONMENT PROJECT													
YES	48	94	43	84	93	48	0	14	48	55	43	32	57
NO	44	98	39	84	93	49	1	20	40	47	42	31	55
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT													
YES	46	97	43	84	93	50	0	17	43	51	41	29	56
NO	45	96	38	84	93	46	1	18	42	48	44	34	55

1. Which of the following animals do NOT lay eggs?

1% 1 ○ Chickens
95% 2 ● Dogs
1% 3 ○ Frogs
0% 4 ○ Turtles

1% 5 ○ I don't know

4. Which of the following insects spread serious human diseases?

4% 1 ○ Ants
25% 2 ○ Honeybees
41% 3 ● Houseflies
18% 4 ○ Moths

12% 5 ○ I don't know.

7. Which of the following animals has scales over most of its body?

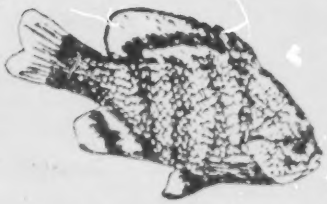
A

Turtle

B

Frog

C



Fish

D

Rabbit

9% 1 ○ A

2% 2 ○ B

83% 3 ● C

3% 4 ○ D

3% 5 ○ I don't know.

17. Which of the following animals usually hunts for food only at night?

93% 1 ● Bat
2% 2 ○ Dog
0% 3 ○ Horse
4% 4 ○ Hummingbird

1% 5 ○ I don't know.

45. Which part of a plant contains the new plant?

45% 1 ○ the roots
7% 2 ○ the leaves
6% 3 ○ the flowers
48% 4 ● the seeds

3% 5 ○ I don't know.

47. Bionic means

70% 1 ○ super-strong.
1% 2 ● learning how nature solves problems.
2% 3 ○ taking a lot of vitamins.
26% 4 ○ not human.

1% 5 ○ I don't know

49. A terrestrial animal

40% 1 ○ lives on both land and water.
6% 2 ○ rests all the time.
9% 3 ○ lives in the water.
17% 4 ● lives on land.

27% 5 ○ I don't know.

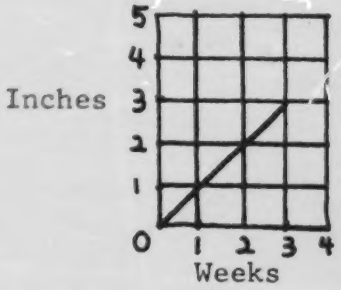
53. An amphibious animal lives

12% 1 ○ in trees.
14% 2 ○ only on land.
10% 3 ○ only in water.
43% 4 ● on land and in water.

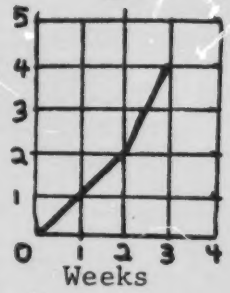
20% 5 ○ I don't know.

20. A plant grows this way: The first week it is 1 inch high. The second week it is 2 inches high. The third week it is 4 inches high. Which of the following graphs shows this growth?

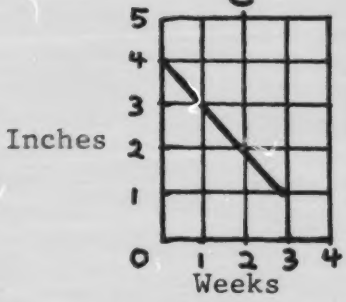
A



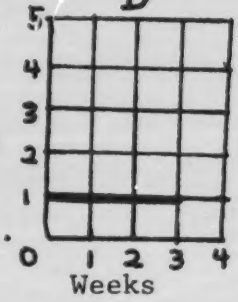
B



C



D



9% 1 ○ A

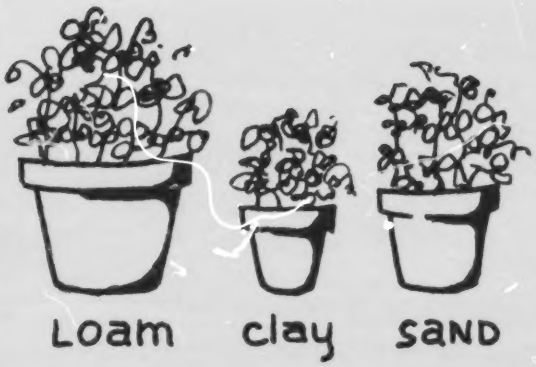
49% 2 ● B

18% 3 ○ C

12% 4 ○ D

12% 5 ○ I don't know.

33. Tom wanted to learn which of three types of soil - clay, sand, or loam - would be best for growing beans. He found three flowerpots, put a different type of soil in each pot, and planted the same number of beans in each, as shown in the drawing. He placed them side by side on the window sill and gave each pot the same amount of water.



Why was Tom's experiment NOT a good one for his purpose?

13% 1 ○ The plants in one pot got more sunlight than the plants in the other pots

42% 2 ● The amount of soil in each pot was not the same

6% 3 ○ One pot should have been placed in the dark

16% 4 ○ Tom should have used different amounts of water

8% 5 ○ It would get too hot on the window sill

16% 6 ○ I don't know.

34. Sam put some seeds on moist cotton in a dish. Jane put some seeds of the same kind into a glass full of water alongside of Sam's. After two days Sam's seeds sprouted but nothing seemed to happen to Jane's. Which of the following is the most likely explanation?

15% 1 ○ Jane's seeds had been kept dry for too long
31% 2 ● Jane did not allow her seeds enough air
10% 3 ○ Jane did not put the glass in a warm enough place
3% 4 ○ Jane should have used a different kind of seed
33% 5 ○ Jane did not use any cotton

7% 6 ○ I don't know.

35. John's pet rabbit was injured by a car and became lame. Some months after the accident she produced a litter. Which of the following describes what the babies would probably be like?

11% 1 ○ All of them would be lame because the mother was
16% 2 ○ Most of them would be lame but not all of them because the father was not lame
8% 3 ○ Most of them would not be lame because the father was not lame
56% 4 ● None of them would be lame because the mother's lameness was due to an accident

10% 5 ○ I don't know.

TABLE 16 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT)
Science Content Area - Chemistry

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE		OBJECTIVE TYPE: UNDERSTANDING			
Question Number		18	46	2	11	16	19
MASSACHUSETTS	60	76	60	77	24	43	60
NATIONAL		66		63	24	39	56
NORTHEAST		70		70	24	42	58
INTERNATIONAL STUDY							
REGION							
BOSTON	60	76	58	72	28	40	62
NORTHEAST	58	76	61	79	21	42	56
PITTSFIELD	72	82	68	77	34	54	75
SOUTHEAST	60	74	56	76	22	40	63
SPRINGFIELD	58	75	63	83	26	44	54
WORCESTER	64	80	65	81	23	49	62
KIND OF COMMUNITY							
BIG CITY	52	66	52	71	22	30	53
INDUSTRIAL SUB	56	80	54	71	22	26	57
RESIDENTIAL SUB	68	85	68	80	29	56	68
OTHER	65	78	65	85	23	51	65
SEX							
FEMALE	62	75	63	71	26	43	61
MALE	59	78	57	83	24	43	61
FAMILY OCC. STATUS							
LOW	54	70	53	75	26	39	55
MEDIUM	61	78	60	78	21	42	62
HIGH	64	80	64	80	26	48	64
LIKE SCHOOL							
LIKE VERY MUCH	57	72	55	72	24	40	59
MOSTLY OK	66	80	65	80	2[illegible]	47	66
MOSTLY NOT OK	64	79	61	8[illegible]	26	41	54
DISLIKE VERY MUCH	50	67	47	77	20	34	52

TABLE 16 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Chemistry

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE		OBJECTIVE TYPE: UNDERSTANDING			
Question Number		18	46	2	11	16	19
SEEN SCIENCE DEMO. OUTSIDE SCHOOL							
YES	64	79	64	79	26	48	63
NO	58	74	56	76	24	39	59
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL							
YES	62	78	62	81	25	45	62
NO	58	74	57	72	24	41	60
WORK ON EXPERIMENT IN YOUR CLASS							
ONCE A WEEK OR MORE	61	77	60	80	25	45	62
ONCE A MONTH	68	78	70	79	24	53	66
A FEW TIMES A YEAR	64	74	64	77	28	44	63
NEVER	54	76	52	73	22	35	57
TALK ABOUT SCIENCE WITH PARENTS							
ONCE A WEEK OR MORE	64	78	64	80	25	43	64
A FEW TIMES A YEAR	65	78	64	80	30	49	66
NEVER	56	75	56	74	22	40	56
TALK ABOUT ENVIRONMENT WITH PARENTS							
ONCE A WEEK OR MORE	61	78	61	74	26	44	61
A FEW TIMES A YEAR	65	78	64	80	27	51	66
NEVER	56	74	56	77	22	37	57

TABLE 16 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Chemistry

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE							
		KNOWLEDGE		UNDERSTANDING					
	Question Number	18	46	2	11	16	19		
TALK ABOUT SCIENCE WITH FRIENDS									
ONCE A WEEK OR MORE	64	78	61	79	25	44	66		
A FEW TIMES A YEAR	65	79	66	79	30	50	64		
NEVER	56	74	56	76	22	38	57		
TALK ABOUT ENVIRONMENT WITH FRIENDS									
ONCE A WEEK OR MORE	62	78	58	78	30	42	66		
A FEW TIMES A YEAR	66	79	67	79	28	51	65		
NEVER	58	75	57	76	21	39	58		
SCHOOL HAD HELP ENVIRONMENT PROJECT									
YES	61	74	60	76	26	47	62		
NO	60	78	60	78	24	41	61		
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT									
YES	62	75	62	77	26	42	63		
NO	58	78	58	77	23	42	59		

18. Iron is most likely to rust when it is

76% 1 ● damp.
5% 2 ○ dry.
3% 3 ○ painted.
3% 4 ○ covered with soap.
9% 5 ○ covered with grease.

3% 6 ○ I don't know.

46. Vitamins are

60% 1 ● chemicals necessary for normal growth.
4% 2 ○ things that cause disease.
3% 3 ○ used in coloring food.
26% 4 ○ things that can be used instead of eating any food.

7% 5 ○ I don't know.

2. Which of the following will speed up the burning of a campfire?

77% 1 ● Blow on the fire.
6% 2 ○ Cover the fire with sand.
4% 3 ○ Sprinkle dirt on the fire.
9% 4 ○ Sprinkle water on the fire.

4% 5 ○ I don't know.

11. Evaporation takes place in all of the following cases EXCEPT

10% 1 ○ A wet chalkboard dries.
8% 2 ○ Dewdrops disappear from a leaf.
17% 3 ○ Water disappears from a birdbath.
24% 4 ● The outside of a cold glass gets wet.
18% 5 ○ A swimmer sits in the sun after he leaves the water.

22% 6 ○ I don't know

16. Which of the following dissolves LEAST in water?

43% 1 ● Glass
24% 2 ○ Salt
18% 3 ○ Soap
12% 4 ○ Sugar

4% 5 ○ I don't know

19.

Weights of some Chemical Elements Found in a 100 pound Human	
Calcium	2 pounds
Carbon	18 pounds
Hydrogen	10 pounds
Oxygen	64 pounds
Phosphorus	14 ounces
Sodium	2 ounces
Sulfur	4 ounces

From the chart above, which of the following chemical elements is found in the SMALLEST amount in the body?

15% 1 ○ Calcium

4% 2 ○ Carbon

5% 3 ○ Hydrogen

60% 4 ● Sodium

4% 5 ○ Sulfur

12% 6 ○ I don't know

TABLE 17 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT)
Science Content Area - Ecology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE											
		KNOWLEDGE						UNDERSTANDING		APPRECIATION			
	Question Number	26	28	29	37	41	44	27	32	30	42	43	
MASSACHUSETTS	62	13	79	85	20	63	52	64	68	44	44	62	
NATIONAL													
NORTHEAST													
INTERNATIONAL STUDY													
REGION													
BOSTON	62	15	79	82	19	65	51	64	67	47	46	62	
NORTHEAST	60	7	82	87	20	62	53	60	66	43	40	61	
PITTSFIELD	61	41	84	80	32	64	48	77	73	48	50	61	
SOUTHEAST	60	10	74	85	19	60	53	67	68	36	39	60	
SPRINGFIELD	61	20	83	86	28	69	57	67	64	44	42	61	
WORCESTER	60	12	81	85	21	63	50	60	76	49	47	68	
KIND OF COMMUNITY													
BIG CITY	56	10	73	81	20	63	53	61	60	39	48	56	
INDUSTRIAL SUB	58	6	79	86	20	58	49	58	68	36	51	58	
RESIDENTIAL SUB	64	22	82	86	23	64	53	69	78	54	38	68	
OTHER	63	10	83	87	19	66	51	63	69	42	41	66	
SEX													
FEMALE	64	10	77	85	21	66	53	64	64	43	47	67	
MALE	64	16	81	84	20	60	51	64	72	45	41	59	
FAMILY OCC. STATUS													
LOW	60	5	77	86	20	61	52	63	60	47	43	59	
MEDIUM	60	14	78	85	19	62	52	64	69	42	44	60	
HIGH	63	16	82	87	22	63	51	67	73	48	43	65	
LIKE SCHOOL													
LIKE VERY MUCH	58	11	76	82	21	63	55	58	66	42	37	59	
MOSTLY OK	65	14	82	87	21	65	48	69	70	47	43	66	
MOSTLY NOT OK	59	15	79	83	19	57	62	61	69	46	44	59	
DISLIKE VERY MUCH	59	13	72	84	21	66	53	60	66	33	38	59	

TABLE 17 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Ecology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE											
		KNOWLEDGE						UNDERSTANDING		APPRECIATION			
	Question Number	26	28	29	37	41	44	27	32	30	42	43	
SEEN SCIENCE DEMO. OUTSIDE SCHOOL													
YES	62	17	81	86	21	62	51	66	74	51	42	64	
NO	62	9	77	84	20	64	53	62	64	38	46	62	
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL													
YES	63	14	81	87	22	63	51	65	69	47	43	65	
NO	60	12	77	82	19	63	53	63	67	40	45	60	
WORK ON EXPERIMENT IN YOUR CLASS													
ONCE A WEEK OR MORE	62	13	79	87	20	62	52	66	70	42	43	65	
ONCE A MONTH	59	16	84	85	28	66	53	67	73	56	42	59	
A FEW TIMES A YEAR	65	16	80	85	21	65	51	65	70	51	46	65	
NEVER	59	9	75	81	18	63	52	59	62	38	44	59	
TALK ABOUT SCIENCE WITH PARENTS													
ONCE A WEEK OR MORE	66	17	82	88	22	66	53	66	72	46	43	67	
A FEW TIMES A YEAR	63	16	81	86	24	63	47	67	72	53	46	63	
NEVER	60	10	76	82	18	61	54	61	65	38	43	60	
TALK ABOUT ENVIRONMENT WITH PARENTS													
ONCE A WEEK OR MORE	63	13	79	84	21	63	51	68	70	46	43	64	
A FEW TIMES A YEAR	64	16	83	86	20	64	52	64	71	51	43	67	
NEVER	59	11	76	84	21	63	53	62	65	39	45	59	

TABLE 17 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Ecology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE											
		KNOWLEDGE						UNDERSTANDING		APPRECIATION			
	Question Number	26	28	29	37	41	44	27	32	30	42	43	
TALK ABOUT SCIENCE WITH FRIENDS													
ONCE A WEEK OR MORE	63	14	80	89	21	67	51	66	70	53	40	63	
A FEW TIMES A YEAR	64	17	79	85	20	65	48	67	72	47	44	64	
NEVER	60	11	78	83	20	60	55	62	65	38	45	62	
TALK ABOUT ENVIRONMENT WITH FRIENDS													
ONCE A WEEK OR MORE	63	14	78	88	19	68	48	66	74	54	44	63	
A FEW TIMES A YEAR	65	18	81	86	21	65	50	68	73	49	44	65	
NEVER	60	10	78	83	21	60	55	61	64	38	44	61	
SCHOOL HAD HELP ENVIRONMENT PROJECT													
YES	60	13	77	83	21	63	51	60	67	47	41	64	
NO	62	13	80	86	21	63	53	66	69	43	45	62	
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT													
YES	62	13	78	85	20	65	50	65	67	47	45	62	
NO	62	13	80	85	21	61	54	63	70	40	43	62	
THINK ENVIRONMENTAL PROBLEMS													
VERY DANGEROUS	57	10	76	81	20	67	48	57	58	36	46	57	
SOMEWHAT DANGEROUS	62	16	83	89	22	62	52	69	76	50	42	68	
NOT DANGEROUS AT ALL	58	10	73	78	15	62	58	61	60	40	46	54	

26. Which of the following is a food chain?

13% 1 ● hawk -> snake -> mouse -> seeds
79% 2 ○ apples -> pears -> grapes -> peaches
2% 3 ○ seed -> hawk -> apple -> mouse
3% 4 ○ giraffe -> mouse -> ant -> seeds

4% 5 ○ I don't know.

28. Today, most pollution is caused by

2% 1 ○ wild animals.
2% 2 ○ insects.
79% 3 ● people.
15% 4 ○ bacteria.

2% 5 ○ I don't know.

29. Plants provide food for

6% 1 ○ only insects.
4% 2 ○ only insects and birds.
3% 3 ○ only birds and people.
85% 4 ● most living things.

2% 5 ○ I don't know.

37. What provides the energy that plants need to make food?

25% 1 ○ fertilizer

20% 2 ● sun

25% 3 ○ water

26% 4 ○ soil

4% 5 ○ I don't know.

41. Water pollution is harmful to all living things.

True ● 63% False ___ 34%

44. All laundry detergents harm the water supply about the same.

True ___ 48% False ● 52%

27. Everything in a pond community depends on

16% 1 ○ fish.
64% 2 ● water.
12% 3 ○ plants.
3% 4 ○ sand.

5% 5 ○ I don't know.

32. A certain wild bird has webbed feet. In which of the following places would you be most likely to find it?

16% 1 ○ A forest
8% 2 ○ A meadow
5% 3 ○ A desert
68% 4 ● A lake
4% 5 ○ I don't know

30. The environment can be changed only by

13% 1 ○ adults or older people.

12% 2 ○ large companies.

17% 3 ○ specially trained ecologists.

44% 4 ● everybody including me.

14% 5 ○ I don't know.

42. A city is not as useful as the countryside for studying ecology.

True ___ 56% False ● 44%

43. No matter how much we harm nature it can always heal itself.

True ___ 37% False ● 62%

TABLE 18 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT)
Science Content Area - Earth Science

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE					UNDERSTANDING	
	Question Number	5	6	8	48	52	10	31
MASSACHUSETTS	61	71	58	61	54	60	91	66
NATIONAL		67	54	41			82	
NORTHEAST		74	51	44			85	
INTERNATIONAL STUDY								60
REGION								
BOSTON	62	69	56	62	55	64	93	60
NORTHEAST	61	69	58	61	57	58	89	69
PITTSFIELD	70	59	70	61	73	57	89	70
SOUTHEAST	59	77	58	57	49	59	90	70
SPRINGFIELD	62	66	65	62	48	58	90	62
WORCESTER	64	76	60	64	55	57	93	72
KIND OF COMMUNITY								
BIG CITY	54	68	49	54	49	53	86	56
INDUSTRIAL SUB	57	79	51	57	40	54	96	62
RESIDENTIAL SUB	70	72	68	69	65	70	94	72
OTHER	64	72	64	63	55	61	93	75
SEX								
FEMALE	60	65	59	55	56	60	91	61
MALE	66	77	58	66	53	60	92	73
FAMILY OCC. STATUS								
HIGH	56	64	54	54	43	56	95	68
MEDIUM	62	72	59	62	56	62	90	66
LOW	67	74	62	67	60	65	93	72
LIKE SCHOOL								
LIKE VERY MUCH	58	69	56	55	45	58	89	60
MOSTLY OK	64	72	60	64	61	64	92	70
MOSTLY NOT OK	66	72	59	66	53	59	93	71
DISLIKE VERY MUCH	57	71	57	55	45	49	90	60

TABLE 18 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Earth Science

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE					UNDERSTANDING	
	Question Number	5	6	8	48	52	10	31
SEEN SCIENCE DEMO. OUTSIDE SCHOOL								
YES	66	77	62	65	60	66	93	70
NO	58	67	55	58	50	56	90	64
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL								
YES	63	72	61	63	58	62	93	70
NO	58	71	55	58	50	58	89	63
WORK ON EXPERIMENT IN YOUR CLASS								
ONCE A WEEK OR MORE	65	72	60	62	54	65	92	69
ONCE A MONTH	64	72	59	63	64	64	90	68
A FEW TIMES A YEAR	64	78	61	64	57	59	94	68
NEVER	56	65	53	56	48	52	88	62
TALK ABOUT SCIENCE WITH PARENTS								
ONCE A WEEK OR MORE	64	75	61	64	58	61	94	74
A FEW TIMES A YEAR	66	73	61	65	61	66	93	71
NEVER	58	68	55	58	49	56	89	66
TALK ABOUT ENVIRONMENT WITH PARENTS								
ONCE A WEEK OR MORE	60	70	57	60	58	60	93	69
A FEW TIMES A YEAR	68	75	64	68	60	65	93	70
NEVER	57	70	55	57	49	56	89	64

TABLE 18 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Earth Science

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE					UNDERSTANDING	
	Question Number	5	6	8	48	52	10	31
TALK ABOUT SCIENCE WITH FRIENDS								
ONCE A WEEK OR MORE	63	72	59	63	58	62	91	68
A FEW TIMES A YEAR	66	75	61	66	59	65	94	71
NEVER	58	69	57	58	50	56	90	63
TALK ABOUT ENVIRONMENT WITH FRIENDS								
ONCE A WEEK OR MORE	64	72	57	57	59	64	94	68
A FEW TIMES A YEAR	69	74	62	67	60	69	92	70
NEVER	60	70	57	60	50	54	90	65
SCHOOL HAD HELP ENVIRONMENT PROJECT								
YES	62	72	60	62	56	61	91	68
NO	56	66	47	51	41	57	90	56
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT								
YES	61	73	58	61	55	60	92	67
NO	62	69	59	62	53	59	90	67

5. Each year the Earth moves once around

2% 1 ○ Mars.
2% 2 ○ Venus.
71% 3 ● the Sun.
10% 4 ○ the Moon.
8% 5 ○ all of the other planets.

7% 6 ○ I don't know

6. The tiny grains of sand on the beach are

58% 1 ● pieces of rock.
2% 2 ○ drops of water.
34% 3 ○ crystals of salt
2% 4 ○ splinters of wood.

4% 5 ○ I don't know

8. Most of the Earth's surface is

19% 1 ○ cities and towns.
4% 2 ○ farm land.
10% 3 ○ solid rock.
61% 4 ● water.
1 5 ○ yellow.

6% 6 ○ I don't know.

48. Climate means

54% 1 ● the usual weather in a particular place.
15% 2 ○ hot weather.
10% 3 ○ only a little rain
5% 4 ○ a kind of vitamin

16% 5 ○ I don't know.

52. Tropical lands are

15% 1 ○ far from the Equator.
10% 2 ○ very cold.
60% 3 ● the hottest part of the Earth.
6% 4 ○ part of outer space.

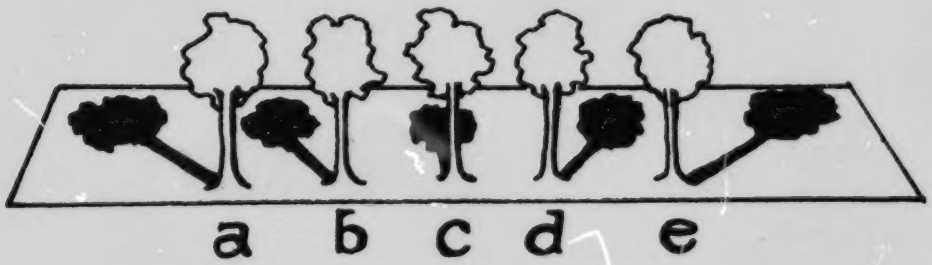
9% 5 ○ I don't know.

10. When it is raining, which of the following must be true?

3% 1 ○ It is spring.
1% 2 ○ The Sun is shining.
4% 3 ○ The wind is blowing.
91% 4 ● There are clouds in the sky.

1% 5 ○ I don't know.

31. At different times during a sunny day a tree was seen to have cast a shadow of different length as shown in the diagrams below. Which diagram shows the shadow at mid-day (12 noon)?



6% 1 ○ A
2% 2 ○ B
56% 3 ● C
4% 4 ○ D
16% 5 ○ E

5% 6 ○ I don't know.

TABLE 19 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT)
Science Content Area - Physics

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE											
			KNOWLEDGE				UNDERSTANDING						
		Question Area	25	38	50	51	3	12	13	14	15	39	
MASSACHUSETTS	54		27	74	32	61	95	47	71	72	43	45	
NATIONAL							86	41	65	83	34		
NORTHEAST							86	43	71	83	34		
INTERNATIONAL STUDY													
REGION													
BOSTON	55		28	76	34	60	95	50	69	66	40	40	
NORTHEAST	50		23	74	31	63	94	46	73	74	46	43	
PITTSFIELD	54		23	80	35	70	98	46	61	82	46	36	
SOUTHEAST	54		24	70	30	57	94	50	70	71	47	48	
SPRINGFIELD	59		39	68	28	62	98	40	76	74	42	56	
WORCESTER	55		30	75	31	67	96	47	72	73	40	53	
KIND OF COMMUNITY													
BIG CITY	48		28	66	25	53	91	41	59	64	37	42	
INDUSTRIAL SUB	54		27	73	30	63	94	44	69	72	40	46	
RESIDENTIAL SUB	62		27	80	40	70	97	53	80	76	46	44	
OTHER	58		26	78	31	64	97	51	78	74	48	51	
SEX													
FEMALE	52		25	72	31	55	95	49	70	67	40	47	
MALE	53		30	76	32	67	95	46	71	74	46	43	
FAMILY OCC. STATUS													
LOW	53		26	68	30	58	95	42	71	70	41	48	
MEDIUM	56		24	77	33	65	94	47	70	75	44	48	
HIGH	59		29	78	33	65	97	53	76	72	44	46	
LIKE SCHOOL													
LIKE VERY MUCH	50		23	70	28	55	93	42	64	69	41	46	
MOSTLY OK	58		29	77	34	66	97	51	76	72	44	46	
MOSTLY NOT OK	54		27	72	31	61	95	48	74	67	47	41	
DISLIKE VERY MUCH	52		28	69	28	56	93	44	59	74	42	48	

TABLE 19 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Physics

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE				UNDERSTANDING					
	Question Number	25	38	50	51	3	12	13	14	15	39
SEEN SCIENCE DEMO. OUTSIDE SCHOOL											
YES	58	30	78	37	65	97	51	76	73	47	46
NO	52	25	72	27	58	93	44	66	69	39	45
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL											
YES	56	28	75	31	63	96	48	74	73	44	46
NO	54	26	73	33	60	93	48	68	68	41	45
WORK ON EXPERIMENT IN YOUR CLASS											
ONCE A WEEK OR MORE	54	28	76	34	61	96	47	74	72	42	46
ONCE A MONTH	59	34	77	34	70	94	51	74	67	49	45
A FEW TIMES A YEAR	56	30	76	33	60	95	53	74	76	46	43
NEVER	52	20	70	27	58	93	43	63	66	38	46
TALK ABOUT SCIENCE WITH PARENTS											
ONCE A WEEK OR MORE	56	34	77	32	62	96	50	74	74	45	44
A FEW TIMES A YEAR	58	29	78	36	65	96	51	74	73	47	48
NEVER	52	23	70	29	59	94	44	68	67	40	45
TALK ABOUT ENVIRONMENT WITH PARENTS											
ONCE A WEEK OR MORE	54	32	74	31	61	96	46	68	69	45	44
A FEW TIMES A YEAR	59	29	79	35	65	97	53	77	75	46	43
NEVER	54	24	71	30	60	93	45	68	69	40	48

TABLE 19 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Physics

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE										
		KNOWLEDGE				UNDERSTANDING						
	Question Number	25	38	50	51	3	12	13	14	15	39
TALK ABOUT SCIENCE WITH FRIENDS											
ONCE A WEEK OR MORE	56	27	75	33	62	96	47	70	72	45	46
A FEW TIMES A YEAR	58	31	77	33	66	96	51	75	73	47	46
NEVER	52	25	72	30	59	93	46	69	69	40	44
TALK ABOUT ENVIRONMENT WITH FRIENDS											
ONCE A WEEK OR MORE	54	31	76	30	62	95	46	67	72	42	45
A FEW TIMES A YEAR	58	28	76	38	66	97	50	77	77	50	44
NEVER	52	25	73	29	59	94	46	69	68	40	46
SCHOOL HAD HELP ENVIRONMENT PROJECT											
YES	53	27	73	32	60	95	46	70	74	41	44
NO	56	27	75	31	63	94	48	71	69	44	46
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT											
YES	54	27	76	31	60	95	47	69	72	44	46
NO	56	26	72	32	64	94	48	72	70	42	45

25. All matter is made up of

4% 1 ○ water.
27% 2 ○ energy.
27% 3 ● molecules.
15% 4 ○ cells.
26% 5 ○ I don't know.

38. The unit of measure for temperature is

8% 1 ○ inches.
4% 2 ○ minutes.
74% 3 ● degrees.
8% 4 ○ meters.

6% 5 ○ I don't know.

50. Which is <u>not</u> true about a computer?

32% 1 ● It is a machine that thinks by itself the same way that a person does.

11% 2 ○ It is a machine that remembers things.

21% 3 ○ Human beings must put information into it for it to work.

30% 4 ○ Humans must tell the computer what to do & how to do it.

6% 5 ○ I don't know.

51. A satellite is

10% 1 ○ the same as a star.

61% 2 ● an object that travels around a planet.

13% 3 ○ a mechanical device built to give us light.

5% 4 ○ the same as a planet.

10% 5 ○ I don't know.

3. Which of the following could cause a rainbow?

2% 1 ○ Fog and smog

2% 2 ○ Rain and snow

1% 3 ○ Clouds and ice

95% 4 ● Sunshine and rain

1% 5 ○ I don't know

12. You hold a paper with the word **POPSICLE** in front of you while you look into a mirror as shown in this diagram.

What does the word look like when you see it in the mirror?

10% 1 ○ POPSICLE

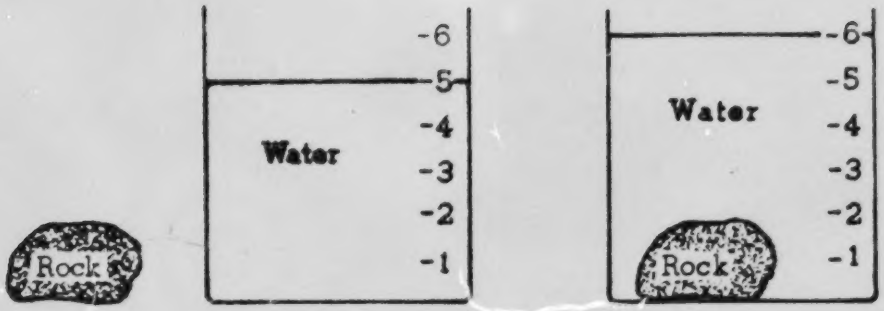
22% 2 ○ ELCISPOP

47% 3 ● POPSICLE

18% 4 ○ ELCISPOP

2% 5 ○ I don't know.

13.



A rock is put into a pail that has some water in it. Before the rock is put into the pail, the water is at the 5-pint line. After the rock is added, the water rises to the 6-pint line. The space taken up by the rock is

71% 1 ● 1 pint.

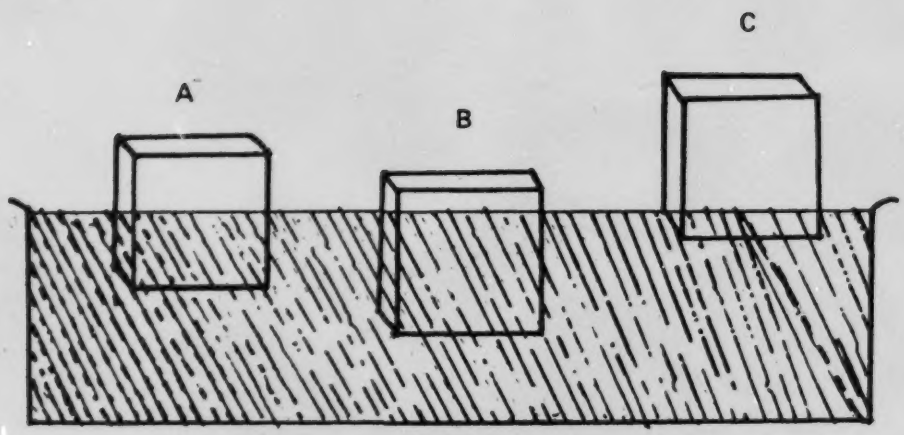
6% 2 ○ 5 pints.

16% 3 ○ 6 pints.

3% 4 ○ 11 pints.

4% 5 ○ I don't know.

14.



The three solid objects shown above have the same volume. If they float as shown in the diagram, which one weighs the most?

1% 1 ○ Object A

72% 2 ● Object B

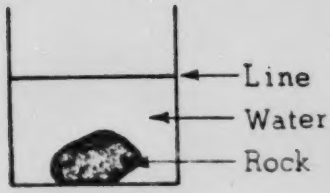
7% 3 ○ Object C

6% 4 ○ They all weigh the same.

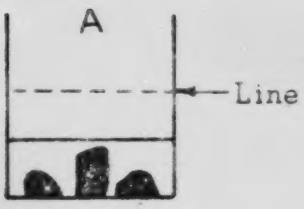
12% 5 ○ It is impossible to tell without additional information.

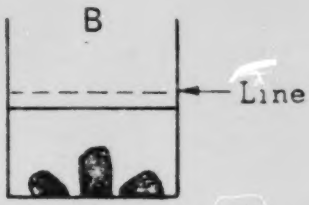
3% 6 ○ I don't know.

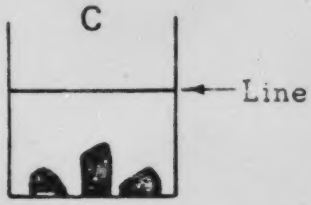
15.

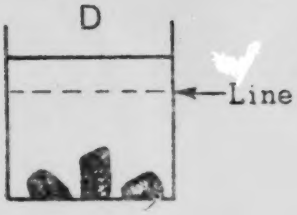


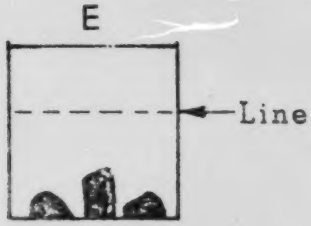
When a rock is put into a pail of water, the water comes up to the line as the picture above shows. If the rock is broken into three pieces, which of the following pictures shows how high the water is?











9% 1 ○ A

11% 2 ○ B

43% 3 ● C

14% 4 ○ D

9% 5 ○ E

14% 6 ○ I don't know.

39. John wants to hear what Susan and Gail are talking about in the next room. Below is a picture of what John does.

Which scientific idea is John using?

5% 1 ○ changing light energy into sound energy

45% 2 ● sound travels best through solid objects

13% 3 ○ sound travels best through the air

2% 4 ○ changing water into sound energy

25% 5 ○ using gravity to improve hearing

10% 6 ○ I don't know.

TABLE 20 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT)
Science Content Area - Unclassified

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE	UNDERSTANDING		APPRECIATION			
Question Number		9	21	23	22	24	36	40
MASSACHUSETTS	38	35	38	33	84	46	20	48
NATIONAL		26	38	41	80	47		
NORTHEAST		26	48	43	82	45		
INTERNATIONAL STUDY								
REGION								
BOSTON	40	40	40	33	86	44	23	48
NORTHEAST	40	29	40	33	82	42	17	49
PITTSFIELD	43	46	36	32	86	61	30	43
SOUTHEAST	34	26	34	34	82	47	18	49
SPRINGFIELD	42	34	42	37	83	46	21	50
WORCESTER	39	39	36	32	84	50	17	49
KIND OF COMMUNITY								
BIG CITY	36	36	26	27	74	40	19	44
INDUSTRIAL SUB	42	28	42	29	90	45	16	50
RESIDENTIAL SUB	47	40	47	40	88	52	24	51
OTHER	44	30	44	36	85	47	17	51
SEX								
FEMALE	41	35	41	2[illegible]	84	44	18	47
MALE	38	35	36	38	84	48	21	50
FAMILY OCC. STATUS								
LOW	37	31	34	37	86	48	20	38
MEDIUM	37	34	37	32	82	47	20	48
HIGH	44	37	44	38	87	49	20	53
LIKE SCHOOL								
LIKE VERY MUCH	38	36	38	30	80	40	22	[illegible]
MOSTLY OK	42	34	42	36	86	49	20	48
MOSTLY NOT OK	36	36	34	33	89	50	15	43
DISLIKE VERY MUCH	34	34	26	30	76	40	21	37

TABLE 20 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Unclassified

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE						
		KNOWLEDGE	UNDERSTANDING		APPRECIATION			
Question Number		9	21	23	22	24	36	40
SEEN SCIENCE DEMO. OUTSIDE SCHOOL								
YES	43	37	43	37	86	46	21	53
NO	34	33	34	31	82	46	18	44
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL								
YES	40	36	40	34	86	48	20	52
NO	36	32	36	34	82	43	18	44
WORK ON EXPERIMENT IN YOUR CLASS								
ONCE A WEEK OR MORE	39	34	39	34	86	49	19	52
ONCE A MONTH	43	38	41	43	87	54	29	49
A FEW TIMES A YEAR	42	34	42	37	83	43	18	49
NEVER	33	35	33	26	82	41	18	43
TALK ABOUT SCIENCE WITH PARENTS								
ONCE A WEEK OR MORE	38	36	38	36	86	44	23	55
A FEW TIMES A YEAR	46	38	46	36	85	50	20	55
NEVER	35	32	35	30	82	44	18	42
TALK ABOUT ENVIRONMENT WITH PARENTS								
ONCE A WEEK OR MORE	37	35	37	37	86	42	22	55
A FEW TIMES A YEAR	44	37	44	33	87	50	18	52
NEVER	36	32	36	32	81	45	19	42

TABLE 20 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 9 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Unclassified

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE						
		KNOWLEDGE	UNDERSTANDING		APPRECIATION			
	Question Number	9	21	23	22	24	36	40
TALK ABOUT SCIENCE WITH FRIENDS								
ONCE A WEEK OR MORE	41	34	41	36	84	46	22	58
A FEW TIMES A YEAR	44	37	44	38	86	47	20	52
NEVER	34	34	34	30	83	45	18	41
TALK ABOUT ENVIRONMENT WITH FRIENDS								
ONCE A WEEK OR MORE	39	36	39	33	81	46	20	54
A FEW TIMES A YEAR	46	39	46	38	86	48	22	56
NEVER	35	32	35	31	84	44	18	43
SCHOOL HAD HELP ENVIRONMENT PROJECT								
YES	38	35	38	34	84	46	20	52
NO	39	34	39	33	84	46	19	46
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT								
YES	38	33	38	35	83	46	20	52
NO	38	35	38	32	84	44	18	45

9. Where do scientific laws come from?

9% 1 ○ Scientists vote on them.

11% 2 ○ They are made by the police.

37% 3 ○ They are passed by Congress.

35% 4 ● They come from scientists doing many experiments.

8% 5 ○ I don't know.

21. You turn on the water faucet in your home and find that no water comes out. Which of the following could NOT have caused this to happen?

38% 1 ● The sink is full of water.
10% 2 ○ The water pipe is full of rust.
18% 3 ○ The water pipe is broken somewhere.
30% 4 ○ Your home has been cut-off from the water supply.

4% 5 ○ I don't know.

23. Scientists would have most trouble testing which of the following?

17% 1 ○ I have a fever.
8% 2 ○ I weigh 101 pounds.
17% 3 ○ I am 62 inches tall.
8% 4 ○ I can lift a 20-pound box.
33% 5 ● My dog is better than your dog.

16% 6 ○ I don't know.

22. Mary blew up a balloon and rubbed it against the wall of her room. When she took her hand away, the balloon stayed on the wall without falling. Mary's friends who saw this said the following things about the balloon. Which is the <u>most</u> scientific?

6% 1 ○ I do not believe that the balloon stayed up.

6% 2 ○ It is a magic trick and cannot be explained.

2% 3 ○ The balloon wanted to stay on the wall and not fall down.

84% 4 ● I cannot explain it, but there must be a reason why it stays up.

2% 5 ○ I don't know.

24. Which of the following will cause you to have bad luck for several years?

34% 1 ○ Breaking a mirror

9% 2 ○ Walking under a ladder

9% 3 ○ Letting a black cat cross your path

46% 4 ● None of these

2% 5 ○ I don't know.

36. Do you agree with the following statement?

The methods of science are fine for scientists, but there is little in these methods to help people with everyday problems.

40% 1 ○ I agree.
20% 2 ● I do not agree.
40% 3 ○ I have no opinion.

40. Do you agree with the following statement?

I enjoy learning about new developments which result from science, whether or not I want to become a scientist.

48% 1 ● Agree
16% 2 ○ Disagree
35% 3 ○ Neither agree nor disagree

TABLE 21 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT)
Science Content Area - Biology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE														
		KNOWLEDGE						UNDERSTANDING								
	Question Number	1	2	19	23	25	27	8	9	16	20	24	43	44	45
MASSACHUSETTS	43	86	65	36	52	24	44	42	56	15	30	58	42	64	33
NATIONAL		86	71					44	55	20					
NORTHEAST		84	73					50	57	21					
INTERNATIONAL STUDY				60							54		51	81	48
REGION															
BOSTON	40	85	58	32	51	24	44	36	53	12	24	52	33	56	28
NORTHEAST	44	87	65	36	56	20	46	42	56	15	35	62	41	66	33
PITTSFIELD	46	89	60	35	57	34	46	32	46	9	29	58	50	73	45
SOUTHEAST	44	88	66	30	48	23	43	44	54	17	29	60	41	67	37
SPRINGFIELD	44	86	66	38	51	16	37	36	60	7	33	54	54	67	24
WORCESTER	49	86	74	43	55	32	48	50	60	17	32	63	45	68	37
KIND OF COMMUNITY															
BIG CITY	38	76	60	28	49	23	38	37	52	12	23	48	32	50	32
INDUSTRIAL SUB	39	88	59	24	54	21	43	32	46	9	20	52	35	64	33
RESIDENTIAL SUB	46	91	71	41	54	27	47	44	62	18	32	63	44	69	33
OTHER	45	86	64	36	52	23	45	44	53	12	35	60	46	68	34
SEX															
FEMALE	44	86	63	36	54	27	44	43	56	13	31	59	35	63	34
MALE	48	88	68	36	52	22	46	42	56	16	31	58	49	67	32
FAMILY OCC. STATUS															
LOW	36	82	60	26	44	21	37	36	53	8	25	53	32	56	36
MEDIUM	45	86	65	34	54	24	46	42	55	16	30	59	44	67	33
HIGH	46	89	68	40	56	26	47	44	60	15	35	61	44	68	31
LIKE SCHOOL															
LIKE VERY MUCH	49	89	73	47	62	25	48	50	61	17	38	64	45	70	28
MOSTLY OK	46	88	67	37	54	26	47	42	58	14	31	60	44	66	33
MOSTLY NOT OK	40	81	58	30	47	21	40	39	49	14	25	54	39	64	35
DISLIKE VERY MUCH	36	88	56	24	41	24	27	40	49	8	29	53	30	54	33

TABLE 21 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Biology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE						UNDERSTANDING							
Question Number		1	2	19	23	25	27	8	9	16	20	24	43	44	45
SEEN SCIENCE DEMO. OUTSIDE SCHOOL															
YES	48	88	69	40	56	27	49	45	59	17	34	62	47	70	32
NO	38	86	60	28	47	20	38	37	52	10	24	52	33	56	34
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL															
YES	50	88	69	39	58	27	52	42	59	17	34	62	48	70	31
NO	41	86	63	34	50	23	40	42	55	12	28	56	38	62	34
TALK ABOUT SCIENCE WITH PARENTS															
ONCE A WEEK OR MORE	58	88	74	53	64	32	58	48	68	20	41	70	57	76	25
A FEW TIMES A YEAR	47	88	70	40	58	25	50	44	58	15	34	64	44	70	35
NEVER	36	86	57	24	42	20	32	38	49	10	22	48	33	53	34
TALK ABOUT ENVIRONMENT WITH PARENTS															
ONCE A WEEK OR MORE	51	85	67	42	53	28	49	44	63	16	35	65	53	74	31
A FEW TIMES A YEAR	45	87	68	39	57	26	47	43	57	14	33	60	42	67	35
NEVER	34	88	55	21	44	18	32	37	47	11	19	45	32	49	28

TABLE 21 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Biology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE													
		KNOWLEDGE						UNDERSTANDING							
	Question Number	1	2	19	23	25	27	8	9	16	20	24	43	44	45
TALK ABOUT SCIENCE WITH FRIENDS															
ONCE A WEEK OR MORE	55	87	73	52	66	30	58	51	68	22	43	69	50	75	29
A FEW TIMES A YEAR	48	87	70	41	57	27	50	45	58	16	32	62	46	71	35
NEVER	36	86	58	24	44	20	34	36	50	9	24	51	35	55	33
TALK ABOUT ENVIRONMENT WITH FRIENDS															
ONCE A WEEK OR MORE	44	84	66	44	50	26	45	43	57	17	33	62	44	65	29
A FEW TIMES A YEAR	46	88	69	38	58	27	48	44	59	16	32	61	45	70	36
NEVER	40	87	56	24	43	18	35	37	50	8	24	49	33	53	30
SCHOOL HAD HELP-ENVIRONMENT PROJECT															
YES	46	88	69	38	56	26	49	44	58	13	34	61	42	69	32
NO	40	85	61	33	48	23	40	40	53	15	26	56	41	60	35
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT															
YES	46	87	67	36	56	23	48	41	56	13	32	58	43	67	32
NO	41	86	64	33	48	25	42	40	55	15	28	58	40	62	33

1. Which of the following is an animal?

5% 1 ○ Bacterium
86% 2 ● Lizard
0% 3 ○ Moss
4% 4 ○ Snapdragon
2% 5 ○ Toadstool

2% 6 ○ I don't know.

2. Which of the following animals is a vertibrate?

4% 1 ○ Clam
65% 2 ● Frog
5% 3 ○ Octopus
5% 4 ○ Spider
14% 5 ○ Starfish

6% 6 ○ I don't know.

19. Which of the following features present in an animal would make you certain it was a mammal?

29% 1 ○ A vertebral column
17% 2 ○ Small tufts of "hair-like" bristles on its skin
5% 3 ○ Two pairs of limbs
36% 4 ● Milk glands
2% 5 ○ Five digits on each fore-limb

11% 6 ○ I don't know.

23. The structure that seems to be most involved with the reproduction of the cell is the

6% 1○ mitochondrion.
14% 2○ cell membrane.
52% 3● nucleus.
6% 4○ cytoplasm.
8% 5○ ribosome.
13% 6○ I don't know.

25. The part of a flower in which pollen is produced is the

6% 1○ sepal.
17% 2○ ovary.
36% 3○ pistil.
4% 4○ stem.
24% 5● stamen.
12% 6○ I don't know.

27. The nucleic acid which contains the information necessary to direct cell activities is

16% 1○ RNA.
5% 2○ ATP.
2% 3○ ADP.
44% 4● DNA.
2% 5○ ribonuclease.
30% 6○ I don't know.

8. In guinea pigs, fur color is dependent on only one pair of genes and black is dominant over white. If no mutations occur, what will happen if a purebred black guinea pig is crossed with a white guinea pig?

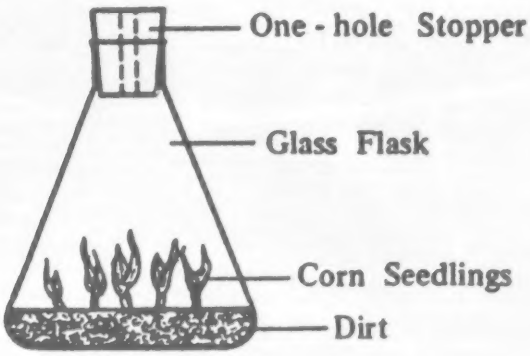
10% 1 ○ 1/2 of the offspring will be black; 1/2 will be white.
38% 2 ○ 3/4 of the offspring will be black; 1/4 will be white.
4% 3 ○ 9/16 of the offspring will be black; 7/16 will be white.
42% 4 ● All of the offspring will be black.
1% 5 ○ All of the offspring will be white

6% 6 ○ I don't know.

9. In terms of the theory of natural selection, what is the explanation of why giraffes have come to have such long necks?

11% 1 ○ Stretching to get food in high trees has made their necks longer.
2% 2 ○ There is something inside of giraffes which keeps making longer necks.
5% 3 ○ Giraffe food contained vitamins which caused the vertebrae to lengthen.
14% 4 ○ Giraffe necks have gotten longer and longer as time has gone on, but nobody has any idea why this is.
56% 5 ● Giraffes born with the longest necks have been able to stay alive when food was scarce and have passed this trait on to their offspring.
12% 6 ○ I don't know.

16. Corn is planted in a flask as shown below. The flask is weighed each day for three weeks. The flask shows a daily weight loss. Which of the following is the best explanation of this loss of weight?



19% 1 ○ The original water evaporates within the first day.

12% 2 ○ Carbon dioxide is lighter in weight than ordinary air.

9% 3 ○ Seed material is changed to leaves and roots that weigh less.

15% 4 ● The seedlings use starch in the seeds and give off gases that escape.

21% 5 ○ Dry air enters through the stopper and replaces the moist air in the flask.

26% 6 ○ I don't know.

20. All of the following are aspects of the reproductive process. Which one of them must occur before we can be <u>certain</u> that fertilization has taken place?

9% 1 ○ A male organism must find a mate

13% 2 ○ Reproductive organs must be produced

30% 3 ● The nucleus of a male gamete must fuse with that of a female gamete

35% 4 ○ A spermatozoon must reach an egg cell

4% 5 ○ A female gamete must provide a store of food for the embryo

9% 6 ○ I don't know.

24. If a corn seed is planted beside some bean seeds, the corn seed will grow into a plant bearing

10% 1 ○ corn and beans.

58% 2 ● corn only.

1% 3 ○ beans only.

20% 4 ○ hybrids having part corn and part bean characteristics.

3% 5 ○ an entirely different vegetable.

7% 6 ○ I don't know.

43. Mushrooms can be grown in the dark because they

11% 1○ are then in a constant temperature.

6% 2○ can then form more vitamins.

8% 3○ need not be pollinated by bees.

42% 4● feed on decaying material.

15% 5○ do not produce seeds.

18% 6○ I don't know.

44. Fossils very similar in shape to marine shellfish which live in oceans today have been found in the rocks of high mountains. The most likely explanation of this is that

5% 1○ the particular marine shellfish can live in the sea or on land.

7% 2○ marine forms once had organs that enabled them to breathe atmospheric air.

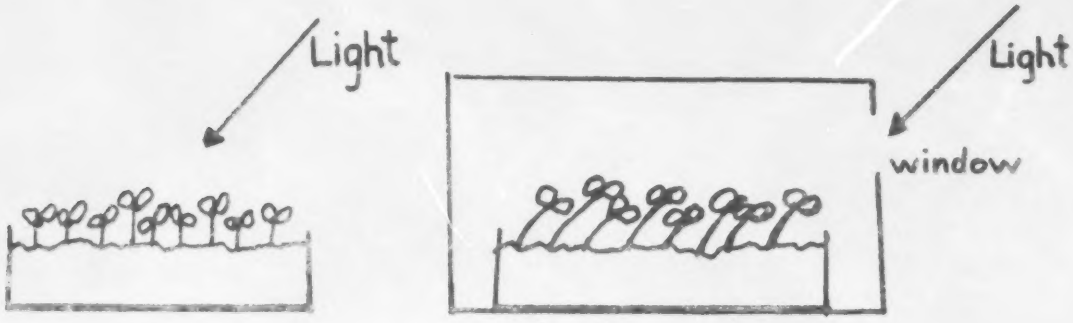
64% 3● the rocks in which the fossils were found were formed under the sea.

6% 4○ marine forms, in certain cases, migrate on to the land.

7% 5○ marine forms have evolved from land forms.

9% 6○ I don't know.

45. Two similar boxes of soil were sown with the same kind of seeds and placed side by side in a greenhouse. One was covered with a light-tight box which had a small "window" cut in one side. The drawings show the appearance of the two sets of seedlings after a few days.



What is the best conclusion from this experiment?

6% 1 ○ The seedlings grow quicker if they are stimulated by light.

46% 2 ○ Seedlings grow towards the light.

33% 3 ● Seedlings grow quicker in limited light and they bend towards the light.

9% 4 ○ Seedlings illuminated on one side bend towards that side.

2% 5 ○ Light slows down the rate of growth of that part of the stem on which it falls.

4% 6 ○ I don't know.

TABLE 22 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT)
Science Content Area - Chemistry

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE									
		KNOWLEDGE				UNDERSTANDING					
	Question Number	3	4	40	47	7	21	38	41	46
MASSACHUSETTS	34	53	54	34	37	17	35	28	10	29
NATIONAL		56	51			21				
NORTHEAST		61	57			23				
INTERNATIONAL STUDY					61		54			56
REGION										
BOSTON	32	51	50	36	32	13	34	27	10	28
NORTHEAST	32	57	53	34	39	18	32	29	10	28
PITTSFIELD	24	43	58	14	26	23	29	22	15	24
SOUTHEAST	33	53	54	33	35	16	38	29	9	27
SPRINGFIELD	32	54	49	32	32	18	35	26	5	27
WORCESTER	38	53	64	41	47	20	38	32	14	36
KIND OF COMMUNITY										
BIG CITY	25	41	45	34	26	16	25	25	9	24
INDUSTRIAL SUB	27	45	48	27	31	15	31	18	6	19
RESIDENTIAL SUB	39	58	59	39	45	19	43	32	14	33
OTHER	33	55	56	32	36	16	33	29	9	31
SEX										
FEMALE	30	51	54	32	32	17	30	27	8	25
MALE	37	55	56	37	42	17	41	30	13	34
FAMILY OCC. STATUS										
LOW	25	44	50	31	25	13	29	25	7	20
MEDIUM	33	53	55	33	40	17	33	28	9	27
HIGH	38	56	59	38	40	19	39	31	13	34
LIKE SCHOOL										
LIKE VERY MUCH	39	61	69	52	53	19	37	39	21	36
MOSTLY OK	35	55	57	35	38	17	36	28	10	30
MOSTLY NOT OK	28	44	42	28	30	16	32	25	9	26
DISLIKE VERY MUCH	25	50	38	18	30	13	25	27	6	25

TABLE 22 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Chemistry

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE									
		KNOWLEDGE				UNDERSTANDING					
	Question Number	3	4	40	47	7	21	38	41	46
SEEN SCIENCE DEMO. OUTSIDE SCHOOL										
YES	40	59	60	40	44	19	40	32	13	35
NO	25	44	46	25	27	14	26	23	7	19
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL										
YES	37	56	58	37	41	20	38	33	13	36
NO	33	52	53	33	35	16	33	26	9	25
TALK ABOUT SCIENCE WITH PARENTS										
ONCE A WEEK OR MORE	48	65	71	53	52	20	45	38	18	48
A FEW TIMES A YEAR	38	56	62	38	43	20	39	32	12	31
NEVER	23	45	40	23	24	13	26	21	7	19
TALK ABOUT ENVIRONMENT WITH PARENTS										
ONCE A WEEK OR MORE	38	56	60	41	45	22	38	31	11	35
A FEW TIMES A YEAR	37	56	57	37	38	17	38	30	11	31
NEVER	23	46	43	24	27	13	23	21	9	21

TABLE 22 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Chemistry

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE									
		KNOWLEDGE				UNDERSTANDING					
	Question Number	3	4	40	47	7	21	38	41	46
TALK ABOUT SCIENCE WITH FRIENDS										
ONCE A WEEK OR MORE	48	62	70	53	54	22	47	39	21	48
A FEW TIMES A YEAR	39	58	63	39	43	19	41	31	10	33
NEVER	23	45	42	23	25	13	24	22	7	19
TALK ABOUT ENVIRONMENT WITH FRIENDS										
ONCE A WEEK OR MORE	35	55	55	35	42	20	37	33	11	34
A FEW TIMES A YEAR	38	57	60	39	41	18	38	30	11	32
NEVER	24	43	42	24	26	14	26	21	9	21
SCHOOL HAD HELP ENVIRONMENT PROJECT										
YES	35	55	59	35	39	18	39	28	11	31
NO	31	50	51	34	36	16	31	29	11	28
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT										
YES	34	53	56	34	37	18	36	28	9	30
NO	33	51	52	33	36	17	34	26	11	28

3. One example of oxidation is the

2% 1 ○ setting of concrete.
53% 2 ● burning of wood in air.
7% 3 ○ neutralizing of an acid.
17% 4 ○ dissolving of CO_2 in water.
8% 5 ○ forming of ice from water.

13% 6 ○ I don't know

4. The particles most directly involved in forming chemical bonds are

54% 1 ● electrons.
14% 2 ○ neutrons.
2% 3 ○ photons.
1% 4 ○ positrons.
14% 5 ○ protons.

13% 6 ○ I don't know.

40. In an electrically neutral atom the number of electrons in the energy levels outside the nucleus is equal to the

4% 1 ○ charge on the ion.

8% 2 ○ atomic weight.

10% 3 ○ number of neutrons in the nucleus.

34% 4 ● number of protons in the nucleus.

13% 5 ○ atomic mass number

29% 6 ○ I don't know.

47. Which one of the following substances does NOT consist mainly of carbon atoms?

15% 1 ○ Diamond

10% 2 ○ Graphite

14% 3 ○ Soot

37% 4 ● Ruby

5% 5 ○ Charcoal

17% 6 ○ I don't know.

EXCEPT

5% 1○ speed up the reaction.

23% 2○ change the principal product.

16% 3○ make a reaction economically important.

6% 4● change the temperature used for the reaction.

17% 5○ change the amounts of products and reactants present at equilibrium.

32% 6○ I don't know.

21. When 16 g of dilute sulphuric acid was poured onto 3 g of zinc in an open test tube, hydrogen gas was generated. What was the weight of the contents of the test tube after the reaction was completed?

5% 1○ Slightly more than 19 g

35% 2● Slightly less than 19 g

12% 3○ Equal to 19 g

12% 4○ Slightly less than 16 g

5% 5○ Equal to 16 g

30% 6○ I don't know.

38. The rusting of iron is a chemical change because

28% 1● a new substance is formed.

4% 2○ heat is evolved.

2% 3○ the molecules remain the same.

51% 4○ decomposition has occurred.

5% 5○ heat is absorbed.

9% 6○ I don't know.

41. The pH of the weakly basic solution of baking soda would be approximately

19% 1 ○ 2.0.

9% 2 ○ 6.0.

8% 3 ○ 7.0.

10% 4 ● 8.0.

5% 5 ○ 11.0.

48% 6 ○ I don't know.

46. Flour is a fine powder obtained by grinding wheat or other cereal grains. A pile of grain burns only very slowly whereas flour dust suspended in the air is explosive. Which of the following is the best explanation of this?

8% 1 ○ The heat produced when small particles burn is greater than the heat produced by the burning of large particles of the same substance.

15% 2 ○ Grinding the grain changes its chemical composition.

29% 3 ● For the same quantity of the material small particles have a greater surface area in contact with the air than large particles.

6% 4 ○ Small particles possess more energy than large particles.

9% 5 ○ The flour burns completely whereas the grain does not.

32% 6 ○ I don't know.

TABLE 23 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT)
Science Content Area - Ecology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE									
		KNOWLEDGE			UNDERSTANDING						APPRECIATION
	Question Number	39	53	55	11	18	22	26	42	54	17
MASSACHUSETTS	48	74	45	37	52	40	21	66	57	17	76
NATIONAL											78
NORTHEAST											78
INTERNATIONAL STUDY									83		
REGION											
BOSTON	47	74	44	36	43	37	21	59	50	19	78
NORTHEAST	52	74	44	34	59	42	21	66	60	18	75
PITTSFIELD	48	77	46	41	51	35	23	55	58	12	77
SOUTHEAST	46	76	42	41	49	42	22	65	55	15	74
SPRINGFIELD	46	75	42	40	50	40	16	67	55	14	78
WORCESTER	55	74	52	42	58	41	25	73	65	21	77
KIND OF COMMUNITY											
BIG CITY	38	67	34	38	37	32	22	55	50	14	79
INDUSTRIAL SUB	40	73	40	33	40	33	21	67	50	10	79
RESIDENTIAL SUB	56	79	54	39	57	46	20	71	64	20	76
OTHER	50	74	43	39	56	40	24	64	56	18	76
SEX											
FEMALE	44	74	43	38	45	38	21	62	56	16	78
MALE	45	75	48	38	60	42	22	69	60	19	76
FAMILY OCC. STATUS											
LOW	40	66	34	37	42	31	15	64	47	12	74
MEDIUM	48	72	44	39	53	40	21	68	57	16	77
HIGH	53	78	50	40	56	43	23	68	62	20	77
LIKE SCHOOL											
LIKE VERY MUCH	54	79	51	41	56	42	22	74	69	20	82
MOSTLY OK	50	75	47	38	53	41	22	67	60	17	78
MOSTLY NOT OK	46	74	40	42	51	35	21	61	50	19	74
DISLIKE VERY MUCH	36	64	33	26	50	34	21	55	47	15	58

TABLE 23 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Ecology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE										
		KNOWLEDGE			UNDERSTANDING						APPRECIATION
	Question Number	39	53	55	11	18	22	26	42	54	17
SEEN SCIENCE DEMO. OUTSIDE SCHOOL											
YES	54	78	50	39	57	45	23	70	62	20	80
NO	40	69	37	37	44	32	18	58	51	13	72
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL											
YES	51	75	45	41	57	44	24	69	62	22	80
NO	48	74	46	36	50	37	20	64	55	15	75
TALK ABOUT SCIENCE WITH PARENTS											
ONCE A WEEK OR MORE	64	87	59	42	68	55	22	78	71	29	80
A FEW TIMES A YEAR	52	76	49	38	56	43	23	69	62	17	79
NEVER	39	67	35	37	41	30	19	58	47	14	73
TALK ABOUT ENVIRONMENT WITH PARENTS											
ONCE A WEEK OR MORE	56	82	53	40	59	48	23	71	62	21	81
A FEW TIMES A YEAR	50	76	46	39	53	40	22	68	60	17	78
NEVER	39	63	35	34	43	29	20	53	46	17	69

TABLE 23 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Ecology

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE									
		KNOWLEDGE			UNDERSTANDING						APPRECIATION
	Question Number	39	53	55	11	18	22	26	42	54	17
TALK ABOUT SCIENCE WITH FRIENDS											
ONCE A WEEK OR MORE	62	84	60	42	65	53	23	78	68	31	79
A FEW TIMES A YEAR	54	78	50	40	59	43	22	71	65	18	81
NEVER	38	68	35	35	41	32	21	56	46	13	72
TALK ABOUT ENVIRONMENT WITH FRIENDS											
ONCE A WEEK OR MORE	56	77	52	44	60	41	22	68	61	23	73
A FEW TIMES A YEAR	52	78	48	38	55	42	22	70	63	18	80
NEVER	38	64	35	35	40	33	20	54	43	13	71
SCHOOL HAD HELP-ENVIRONMENT PROJECT											
YES	52	76	48	39	55	41	20	67	60	19	81
NO	46	72	43	38	49	39	23	64	55	16	71
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT											
YES	50	75	46	40	55	38	22	66	58	17	81
NO	46	73	44	37	48	41	23	63	55	19	72
THINK ENVIRONMENTAL PROBLEMS											
VERY DANGEROUS	58	77	51	40	65	45	22	74	64	20	71
SOMEWHAT DANGEROUS	48	76	45	37	50	39	22	65	58	17	81
NOT DANGEROUS AT ALL	40	61	36	42	40	41	23	46	39	14	68

39. How is man different from all other living things in an ecosystem?

74% 1● he can make changes in his environment
7% 2○ he needs to be sheltered from the cold
2% 3○ he sunbathes in the summertime
8% 4○ he can breathe pure oxygen
8% 5○ I don't know.

53. The organisms in a food chain responsible for converting light energy to a usable form are called

7% 1○ consumers.
45% 2● producers.
16% 3○ decomposers.
8% 4○ herbivores.
23% 5○ I don't know.

55. Animals get nitrogen for building proteins from

7% 1○ other animals.
22% 2○ the atmosphere.
37% 3● from plants.
18% 4○ from minerals in water.
14% 5○ I don't know.

11. Hunters have killed all of the wolves and cougars in a forest community. Which of the following is likely to happen?

22% 1 ○ other animals in this community would take over the function of wolves and cougars.

10% 2 ○ there would be no change at all.

7% 3 ○ there would be no change in the vegetation.

52% 4 ● there would be too many deer.

8% 5 ○ I don't know.

18. A farmer uses a phosphate fertilizer to take care of his crops. Which of the following is NOT true?

13% 1 ○ This fertilizer may eventually kill fish.

12% 2 ○ Many more plants per acre will grow than without this fertilization.

40% 3 ● People eating these crops would become ill shortly after eating them.

18% 4 ○ This is the same kind of chemical that we have heard about in detergent products.

16% 5 ○ I don't know.

22. The fact that the number of organisms decreases with each step up a food chain is <u>best</u> explained by

27% 1○ the larger size of organisms at later steps in the food chain.

21% 2● energy loss at each step in the chain.

4% 3○ a lack of chlorophyl in vertebrate animals.

13% 4○ early steps are mostly plants.

32% 5○ I don't know.

26. The plant process of photosynthesis is useful to animals because a major by-product is

19% 1○ carbon dioxide.

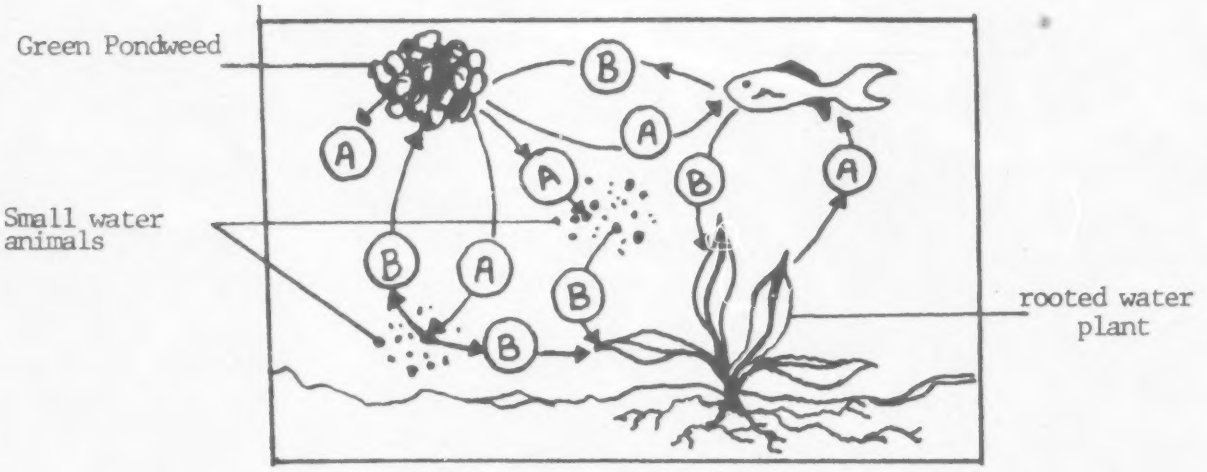
66% 2● oxygen

4% 3○ phosphorus

4% 4○ carbon monoxide

7% 5○ I don't know.

42. The diagram below shows an example of interdependence among aquatic organisms. During the day the organisms either use up or give off (A) or (B) as shown by the arrows.



Choose the right answer for (A) and (B) from the alternatives given.

57% 1 ● A is oxygen and B is carbon dioxide

5% 2 ○ A is oxygen ard B is carbohydrate

4% 3 ○ A is nitrogen and B is carbon dioxide

15% 4 ○ A is carbon dioxide and B is oxygen

2% 5 ○ A is carbon dioxide and B is carbohydrate

15% 6 ○ I don't know.

54. A primary consumer in a food chain is

25% 1 ○ the grass.

33% 2 ○ the hawk.

17% 3 ● the mouse.

9% 4 ○ the snake.

12% 5 ○ I don't know

17. A coal-burning electric power plant is proposed in your area. The power plant will reduce the cost of electricity as well as prevent future power failures. It will also discharge heat into the environment and cause some air pollution. Which one of the following best describes YOUR reaction to the proposed construction of this power plant?

3% 1 ○ Build it. I can save money.

2% 2 ○ Built it. It will be good for my community.

0% 3 ○ Build it. I'll have all the electricity I need.

15% 4 ○ Don't build it since it will pollute the water and the air.

76% 5 ● Don't build it without first determining the effect on the environment.

3% 6 ○ I don't have any reaction.

TABLE 24 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT)
Science Content Area - Earth Science

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE		UNDERSTANDING	
Question Number		49	51	50	52
MASSACHUSETTS	44	51	32	37	62
NATIONAL					
NORTHEAST					
INTERNATIONAL STUDY					
REGION					
BOSTON	43	45	30	41	60
NORTHEAST	42	53	31	32	62
PITTSFIELD	42	60	40	31	43
SOUTHEAST	46	53	26	39	67
SPRINGFIELD	42	48	32	36	61
WORCESTER	46	54	38	37	69
KIND OF COMMUNITY					
BIG CITY	35	38	29	32	57
INDUSTRIAL SUB	48	50	31	46	54
RESIDENTIAL SUB	34	51	34	36	70
OTHER	47	57	32	37	62
SEX					
FEMALE	38	47	27	28	61
MALE	50	55	38	45	66
FAMILY OCC. STATUS					
LOW	42	50	34	32	60
MEDIUM	44	54	31	35	63
HIGH	44	51	33	38	66
LIKE SCHOOL					
LIKE VERY MUCH	45	49	29	41	66
MOSTLY OK	45	53	33	37	66
MOSTLY NOT OK	42	50	33	33	56
DISLIKE VERY MUCH	38	41	25	35	55

TABLE 24 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Earth Science

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE			
		KNOWLEDGE		UNDERSTANDING	
Question Number		49	51	50	52
SEEN SCIENCE DEMO. OUTSIDE SCHOOL					
YES	47	55	35	39	67
NO	40	45	28	34	56
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL					
YES	48	53	36	42	67
NO	42	50	29	33	61
TALK ABOUT SCIENCE WITH PARENTS					
ONCE A WEEK OR MORE	50	58	35	42	71
A FEW TIMES A YEAR	46	56	35	37	68
NEVER	40	44	27	35	56
TALK ABOUT ENVIRONMENT WITH PARENTS					
ONCE A WEEK OR MORE	46	53	33	38	65
A FEW TIMES A YEAR	46	54	33	37	66
NEVER	38	42	27	35	53

TABLE 24 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Earth Science

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE			
		KNOWLEDGE		UNDERSTANDING	
	Question Number	49	51	50	52
TALK ABOUT SCIENCE WITH FRIENDS					
ONCE A WEEK OR MORE	48	55	39	42	73
A FEW TIMES A YEAR	46	53	36	38	68
NEVER	40	47	25	34	56
TALK ABOUT ENVIRONMENT WITH FRIENDS					
ONCE A WEEK OR MORE	46	50	41	39	63
A FEW TIMES A YEAR	46	54	32	37	68
NEVER	40	45	24	36	52
SCHOOL HAD HELP ENVIRONMENT PROJECT					
YES	45	52	33	38	66
NO	44	51	32	36	60
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT					
YES	44	52	32	36	64
NO	44	51	32	38	62

49. When a low pressure area moves into your vicinity it usually brings

29% 1 ○ cool dry air.

51% 2 ● clouds and precipitation.

6% 3 ○ hot dry winds.

2% 4 ○ winds that spiral outward.

4% 5 ○ bright clean air.

9% 6 ○ I don't know.

51. Which of the following pairs of planets have nearly the same diameter?

5% 1 ○ Jupiter and Mars

32% 2 ● Earth and Venus

11% 3 ○ Uranus and Earth

18% 4 ○ Venus and Mars

6% 5 ○ Saturn and Mars

28% 6 ○ I don't know.

50. If the sun suddenly stopped radiating light we would not know it until

37% 1 ● 8 minutes later.

10% 2 ○ 8 hours later.

5% 3 ○ 8 days later.

4% 4 ○ 8 years later.

20% 5 ○ 8 light years later.

23% 6 ○ I don't know.

52. The length of day and night would be equal everywhere on earth if the earth

62% 1 ● did not have a tilted axis.

3% 2 ○ was further from the sun.

10% 3 ○ rotated more quickly on its axis.

5% 4 ○ had no moon.

6% 5 ○ revolved around the sun more slowly.

12% 6 ○ I don't know.

TABLE 25 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT)
Science Content Area - Physics

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: KNOWLEDGE			UNDERSTANDING										
	Question Number	5	35	36	6	10	28	29	30	31	32	33	34	37	48
MASSACHUSETTS	34	39	16	22	34	78	22	50	21	73	55	14	41	18	34
NATIONAL		41			27	75									
NORTHEAST		43			24	78									
INTERNATIONAL STUDY															
REGION															
BOSTON	30	33	14	22	30	68	17	43	18	69	58	12	34	13	31
NORTHEAST	38	39	16	18	39	82	18	58	25	72	66	12	40	16	36
PITTSFIELD	30	39	22	26	29	80	18	32	27	72	66	15	32	15	35
SOUTHEAST	33	38	15	24	33	77	27	50	17	76	68	16	39	22	33
SPRINGFIELD	30	41	15	22	30	88	27	46	15	76	76	14	42	20	31
WORCESTER	39	43	22	22	38	79	25	54	25	75	72	16	51	19	40
KIND OF COMMUNITY															
BIG CITY	28	30	14	22	26	73	17	38	15	68	58	14	31	13	30
INDUSTRIAL SUB	30	32	15	22	29	71	16	47	23	69	61	9	38	12	40
RESIDENTIAL SUB	36	45	19	24	39	78	22	59	23	74	70	14	47	20	34
OTHER	35	37	15	20	34	82	26	46	20	76	69	15	41	20	36
SEX															
FEMALE	30	38	10	17	27	73	16	41	17	72	61	9	36	9	33
MALE	38	40	23	26	41	83	27	59	24	75	72	19	47	27	36
FAMILY OCC. STATUS															
LOW	30	32	13	14	29	74	18	45	19	74	69	14	31	13	36
MEDIUM	34	39	16	18	33	82	20	48	19	74	68	13	41	17	35
HIGH	36	43	18	26	38	78	24	55	24	75	67	16	46	20	35
LIKE SCHOOL															
LIKE VERY MUCH	40	52	29	32	48	76	28	70	24	84	71	11	50	22	32
MOSTLY OK	35	39	17	23	34	80	23	50	21	75	67	15	42	18	36
MOSTLY NOT OK	34	35	11	13	27	75	17	40	18	64	66	15	37	16	32
DISLIKE VERY MUCH	30	30	8	19	30	71	12	43	20	59	60	7	33	8	29

TABLE 25 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Physics

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE														
		KNOWLEDGE			UNDERSTANDING											
	Question Number	5	35	36	6	10	28	29	30	31	32	33	34	37	48	
SEEN SCIENCE DEMO. OUTSIDE SCHOOL																
YES	37	43	20	26	39	81	25	56	23	80	71	17	48	21	35	
NO	28	31	21	15	26	73	16	40	16	63	59	10	30	13	34	
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL																
YES	36	41	20	25	36	78	24	54	23	78	69	15	44	20	36	
NO	34	37	14	20	33	78	20	48	20	71	66	14	40	17	34	
TALK ABOUT SCIENCE WITH PARENTS																
ONCE A WEEK OR MORE	39	54	31	31	44	82	33	68	22	86	74	17	50	21	34	
A FEW TIMES A YEAR	36	41	18	22	37	80	24	52	24	77	71	15	45	20	36	
NEVER	28	29	18	17	26	75	14	41	16	62	58	12	33	14	33	
TALK ABOUT ENVIRONMENT WITH PARENTS																
ONCE A WEEK OR MORE	38	46	22	25	38	81	23	54	20	80	72	14	43	19	37	
A FEW TIMES A YEAR	34	39	16	23	35	79	23	52	22	76	68	14	44	19	34	
NEVER	31	30	11	15	26	72	16	42	19	60	57	14	32	13	32	

TABLE 25 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd.
Science Content Area - Physics

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE													
		KNOWLEDGE			UNDERSTANDING										
	Question Number	5	35	36	6	10	28	29	30	31	32	33	34	37	4
TALK ABOUT SCIENCE WITH FRIENDS															
ONCE A WEEK OR MORE	40	54	31	33	48	83	33	64	30	82	79	20	51	26	3
A FEW TIMES A YEAR	38	42	19	24	37	81	25	55	22	80	70	16	47	21	3
NEVER	28	30	8	16	25	74	14	40	16	63	58	10	32	12	3
TALK ABOUT ENVIRONMENT WITH FRIENDS															
ONCE A WEEK OR MORE	34	41	22	23	35	78	24	54	[illegible]	73	71	16	42	20	3
A FEW TIMES A YEAR	36	42	17	24	37	80	24	53	24	79	68	15	45	19	3
NEVER	26	27	11	14	26	74	16	42	16	60	59	11	33	14	3
SCHOOL HAD HELP ENVIRONMENT PROJECT															
YES	36	39	17	23	37	78	21	52	23	76	70	14	42	20	3
NO	34	38	15	21	31	77	24	48	18	71	63	14	41	16	3
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT															
YES	32	35	15	19	32	79	20	48	22	75	66	13	40	17	3
NO	34	40	16	22	34	76	23	49	20	70	67	16	41	18	3

5. A refrigerator keeps its contents cool by

11% 1○ freshening food.
39% 2● transferring heat.
22% 3○ removing moisture.
3% 4○ destroying energy.
17% 5○ keeping ice from melting.

8% 6○ I don't know.

35. The half-life of a radioactive substance depends upon

3% 1○ pressure.
6% 2○ temperature.
21% 3○ the amount of the substance.
15% 4○ electric fields.
16% 5● no external influences.

37% 6○ I don't know.

36. Which of the following statements concerning static electricity is true?

14% 1○ Like charges attract.
22% 2● The force between two charges varies inversely with the square of the distance between the charges.
11% 3○ Unlike charges repel.
4% 4○ Uncharged objects attract uncharged objects
22% 5○ An uncharged body possesses different amounts of positive and negative charge.

27% 6○ I don't know.

6. Suppose that a rubber balloon filled with air does not leak and that it is taken from Earth to the Moon. One can be sure that on the Moon, the balloon will have the same

43% 1○ size as on Earth.

34% 2● mass as on Earth.

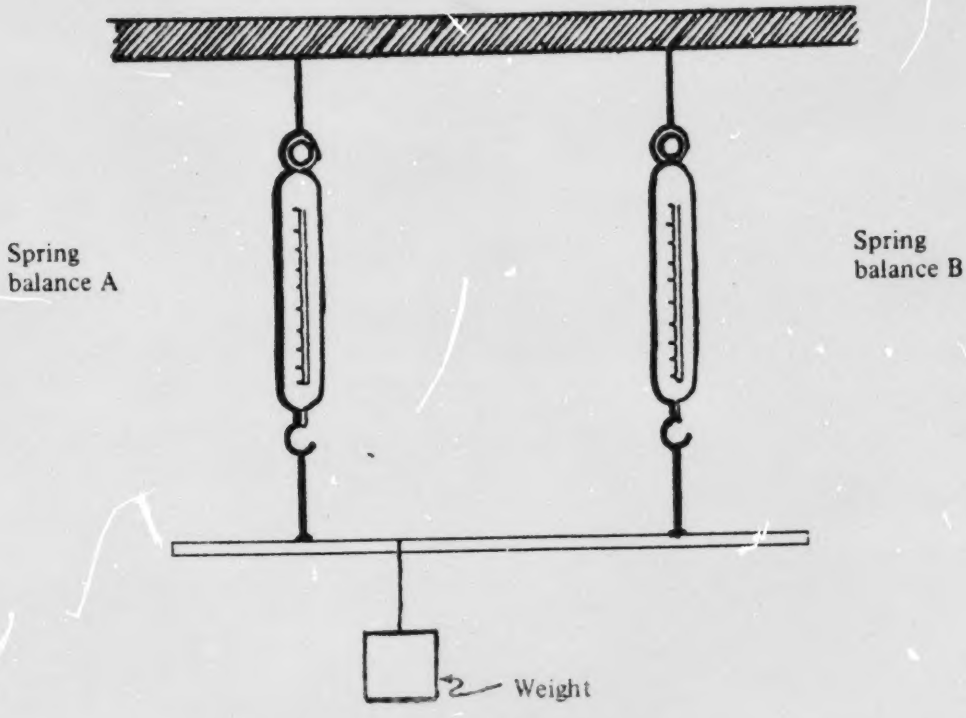
3% 3○ weight as on Earth.

1% 4○ rate of fall as on Earth.

14% 5○ ability to float as on Earth.

5% 6○ I don't know.

10. Two identical spring balances are arranged as shown. Which spring balance will show the higher reading?



78% 1 ● A

9% 2 ○ B

4% 3 ○ Both spring balances will show the same reading.

6% 4 ○ One cannot predict which spring balance will show the higher reading.

5% 5 ○ I don't know.

lifts a 150 pound bar-bell three feet straight up?

5% 1 ○ 185 foot-pounds

22% 2 ● 450 foot-pounds

14% 3 ○ 335 foot-pounds

7% 4 ○ 235 foot-pounds

21% 5 ○ 150 foot-pounds

29% 6 ○ I don't know.

29. Which of the following concepts can be used to explain why a horseback rider is sometimes thrown forward over a horse's head when the horse stops suddenly?

7% 1 ○ buoyancy

7% 2 ○ friction

21% 3 ○ potential energy

50% 4 ● inertia

6% 5 ○ mechanical advantage

10% 6 ○ I don't know.

30. 20 degrees Celsius is comparable to a reading on the Fahrenheit scale of

20% 1 ○ 40 degrees.

21% 2 ○ 55 degrees.

21% 3 ● 68 degrees.

8% 4 ○ 75 degrees.

7% 5 ○ 82 degrees.

23% 6 ○ I don't know.

31. In which of the following ways does a sample of steam differ from a sample of ice? The molecules of steam

1% 1 ○ move more slowly.
5% 2 ○ are smaller.
3% 3 ○ contain less energy.
4% 4 ○ are closed together.
73% 5 ● move more quickly.

11% 6 ○ I don't know.

32. If the volume of a gas is held constant and its temperature is increased, then

9% 1 ○ its pressure decreases
4% 2 ○ its pressure remains constant.
7% 3 ○ the number of gas molecules increases.
55% 4 ● its pressure increases.
7% 5 ○ its volume increases.

15% 6 ○ I don't know

33. Sound travels

24% 1 ○ faster in a vacuum than in air.
15% 2 ○ at the same speed as light.
12% 3 ● faster in cold air than in hot air.
14% 4 ○ faster in water than in air at the same temperature.
15% 5 ○ at the same speed in all materials at the same temperature

19% 6 ○ I don't know.

34. When viewed from the side, a drinking straw in a glass of water appears to be bent because of the

41% 1 ● refraction of light.
8% 2 ○ dispersion of light.
21% 3 ○ reflection of light.
12% 4 ○ diffraction of light.
6% 5 ○ interference of light.
11% 6 ○ I don't know.

37. A toaster draws a current of 15 amperes when connected to a 120 volt power source. Its resistance is

5% 1 ○ 0.125 ohm
18% 2 ● 8 ohm
5% 3 ○ 16 ohm
8% 4 ○ 120 ohm
6% 5 ○ 1800 ohm
57% 6 ○ I don't know.

48. The distance traveled in the hundred yard dash divided by the elapsed time is called

34% 1 ● the average speed.
18% 2 ○ the velocity.
15% 3 ○ the average velocity.
6% 4 ○ the instantaneous speed
11% 5 ○ The average acceleration.
15% 6 ○ I don't know.

TABLE 26 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT)
Science Content Area - Unclassified

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: UNDERSTANDING	APPRECIATION		
	Question Number	12	13	14	15
MASSACHUSETTS	61	62	60	13	69
NATIONAL	62	61	64	9	71
NORTHEAST	64	66	63	7	72
INTERNATIONAL STUDY					
REGION					
BOSTON	56	58	54	15	68
NORTHEAST	62	62	63	12	69
PITTSFIELD	56	54	57	12	58
SOUTHEAST	60	61	60	12	67
SPRINGFIELD	61	63	59	12	71
WORCESTER	65	67	63	15	72
KIND OF COMMUNITY					
BIG CITY	50	51	50	14	66
INDUSTRIAL SUB	54	59	50	13	63
RESIDENTIAL SUB	66	68	64	13	70
OTHER	61	61	61	14	71
SEX					
FEMALE	60	59	60	10	68
MALE	63	66	60	16	71
FAMILY OCC. STATUS					
LOW	56	55	56	9	64
MEDIUM	60	62	59	12	70
HIGH	64	65	62	15	73
LIKE SCHOOL					
LIKE VERY MUCH	72	74	69	31	85
MOSTLY OK	62	63	61	12	71
MOSTLY NOT OK	54	55	54	7	60
DISLIKE VERY MUCH	44	52	45	13	44

TABLE 26 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd
Science Content Area - Unclassified

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: UNDERSTANDING	APPRECIATION		
Question Number		12	13	14	15
SEEN SCIENCE DEMO. OUTSIDE SCHOOL					
YES	68	68	67	17	78
NO	50	52	48	6	54
PERFORMED SCIENCE PROJECT OUTSIDE SCHOOL					
YES	64	64	65	20	76
NO	58	61	56	9	64
TALK ABOUT SCIENCE WITH PARENTS					
ONCE A WEEK OR MORE	76	75	77	32	91
A FEW TIMES A YEAR	66	66	65	13	75
NEVER	48	51	45	6	51
TALK ABOUT ENVIRONMENT WITH PARENTS					
ONCE A WEEK OR MORE	67	65	69	21	83
A FEW TIMES A YEAR	64	64	63	12	70
NEVER	46	54	40	8	51

TABLE 26 PERFORMANCE SCORES BY DEMOGRAPHIC CATEGORY FOR 17 YEAR OLDS (IN PERCENT) Cont'd
Science Content Area - Unclassified

DEMOGRAPHIC CATEGORY	MEDIAN FOR CONTENT AREA	OBJECTIVE TYPE: UNDERSTANDING	APPRECIATION		
Question Number		12	13	14	15
TALK ABOUT SCIENCE WITH FRIENDS					
ONCE A WEEK OR MORE	76	76	77	35	89
A FEW TIMES A YEAR	69	68	66	12	78
NEVER	49	51	47	6	52
TALK ABOUT ENVIRONMENT WITH FRIENDS					
ONCE A WEEK OR MORE	63	62	64	22	80
A FEW TIMES A YEAR	66	66	65	12	72
NEVER	48	54	44	8	52
SCHOOL HAD HELP ENVIRONMENT PROJECT					
YES	64	64	63	13	72
NO	58	60	56	14	66
STUDENT PARTICIPATED IN HELP-ENVIRONMENT PROJECT					
YES	61	60	62	14	73
NO	58	61	56	12	64

12. Four of the following are statements of fact. Which statement is a hypothesis?

6% 1 ○ The boiling point of water is 100°C.

11% 2 ○ A gallon of water weighs about 8 pounds.

5% 3 ○ Hydrogen was first prepared by Cavendish in 1766.

5% 4 ○ The Empire State Building is more than 50 stories high.

62% 5 ● The rings of Saturn were formed from a moon that exploded.

12% 6 ○ I don't know.

13. Do you agree with the following statement?

The methods of science are fine for scientists, but there is little in these methods to help people with everyday problems.

24% 1 ○ I agree.

60% 2 ● I do not agree.

16% 3 ○ I have no opinion.

14. I would like to become a scientist.

13% 1 ● Agree

58% 2 ○ Disagree

28% 3 ○ Neither agree nor disagree

15. I enjoy learning about new developments which result from science, whether or not I want to become a scientist.

69% 1 ● Agree

12% 2 ○ Disagree

18% 3 ○ Neither agree nor disagree

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